# MALNUTRITION

# AND

# STARVATION

# IN

# WESTERN NETHERLANDS

SEPTEMBER 1944

JULY 1945

PART I



THE HAGUE
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1948

## INDEX

# FOREWORD

During the German occupation in the years 1940—1945 the Dutch nation has gone through experiences which before that time were completely unknown to it One of these experiences was the serious famine, which especially afflicted the population in the western area of the country during the last months of the occupation

In this book the seriousness of the famine has been fully described However the report on the famine is not the main object of this publication The greatest attention is paid to the description of the way in which the victims of the famine were helped and to the experiences with this work

Of course the fight against the famine consisted in the first place in supplying large quantities of food In case of serious famine this help is not sufficient The patients in an advanced stage of starvation must be helped in a particular way, either policlinically or also clinically in serious cases

Fortunately as early as in January 1945 the initiative was taken in the, at that time, recently liberated southern part of our country to assist the victims of the famine in the northern part immediately after the liberation

For that purpose an important action was prepared, which is unique in history The United Kingdom, The United States and Canada took part in this action together with the Netherlands Prominent experts from these countries were leading the action The highest allied authorities cooperated in procuring the equipment for this organisation

The whole action was undertaken in such a way that the experiences of value from a scientific point of view could be stated exactly

This report and the additional appendices relate „in extenso" the way in which this work was performed A choice collection of scientific data has been gathered in them This is of importance, because the conditions in the field of nutrition in this world are not yet so satisfactory, that a serious famine needs never be feared in future although we hope that international collaboration will succeed in preventing another famine If it should prove necessary to assist on a large scale victims of a famine it will be possible to make a good use of the data mentioned in this report

In publishing this book the Netherlands Government performs a duty of gratitude towards all those who took part in the relief action and particularly towards all those who compiled it Our thoughts are directed primarily to the international „triumvirate" which took care of the final redaction and so greatly contributed to the success of the relief action

Sir JACK DRUMMOND, who belonged to those who took the initiative for the action as is mentioned in the book and who in this function of chairman of the preparatory committee rendered invaluable services before and during the relief action,

Lt Col H R SANDSTEAD who as head of the Health section of the S H A E F mission to the Netherlands contributed so much to the recovery of the health of the population of our country and who was a great support of the relief action,

Dr G C E BURGER, who although always having been concerned in the preparation of the action, was only at the last moment charged with the management of it and nevertheless accomplished his duty in the most perfect way

*The Minister of Social Affairs*

# I INTRODUCTION

When the work described in this Report was drawing to a close, a meeting was convened at the Hague on June 30th 1945, to discuss what should be done to put on record the important observations made during the investigations The meeting confirmed a tentative proposal, previously made that the compilation of a Report should be entrusted to an Editorial Committee

The composition of this Committee was

Netherlands Dr G C E BURGER (Chairman),

U S A and Canada Lt Col H R SANDSTEAD,

Great Britain Sir J C DRUMMOND

Originally the British representative was Professor H F HIMSWORTH, but owing to his illness it was necessary to appoint another Sir JACK DRUMMOND agreed to serve in his place

The meeting approved a plan on which the Report should be based and invited certain experts to contribute or to supervise the preparation of each section With optimism it was anticipated that twelve months would sufice for completion of the Report

It was not foreseen at that time how seriously the preparation of the material for publication would be delayed by the dispersal of those who were concerned, by most of them being obliged to give time and attention preferentially to other work in the post war period and by the very mass of data that needed careful examination

It was not until the spring of 1947 that the work had progressed sufficiently to justify calling the Editorial Committee together, to consider the first draft of the manuscripts At the invitation of the Director General of Public Health for the Netherlands the Committee met at the Hague on May 17th for this purpose Dr J F LOUTIT, of the British Medical Research Council, and Dr J BOK of Leiden University Hospital attended this meeting and assisted the Committee in preparing the final draft of the Report This help was invaluable

Even after an interval of two years the collection of data was incomplete Dr ROCHAT's investigations of the pathological anatomy in starvation were still in progress so with reluctance the Committee agreed to leave out this particularly interesting section of the laboratory work Dr DE JONG has, however, dealt with some of the findings

The Editorial Committee had to consider, when it met on May 1947, whether it was advisable to bring together material from separate reports and attempt to present from it a composite picture of the results obtained from the investigation or whether to include each of the individual reports more or less as they stood, even if this course led to a certain amount of overlapping and duplication

The latter alternative was thought to be preferable and was adopted It was also thought desirable to edit the Report as a whole, so that it would be to a large extent a statement of facts

It did not appear to the Committee prudent to retain discussions of results or theoretical considerations that might not meet with the approval of all who had been concerned with the actual investigations

The Report is, therefore, primarily a factual document based on the various authors original contributions, modified by the Editorial Committee only to the extent thought necessary to bring them into line with the decisions outlined above

Chapter II dealing with Food and Health in the Western Netherlands before liberation was compiled by Dr Bok from a variety of sources, in particular from the valuable report written by Dr Dols and van Arcken that appeared in the Milbank Memorial Fund Quarterly, vol XXIV, n° 4 1946 Chapters III, IV and V were the mainly joint work of the Editorial Committee, who wish to record the help of Lt Col J A F van den Belt in preparing section IIIa

Collation of the survey data from teams A and B was supervised by Dr V P Sydenstricker, a special meeting having been held in Washington D C in the spring of 1946 attended by Dr Sydenstricker Dr J F Mc Creary, Dr F J Stare Dr H D Branion Dr C E French, Dr M B Corlette and Dr H R Sandstead the report dealing with all of the nutrition surveys was prepared

Chapter VI (a) summarises a long report of the Pulse Committee from Dr Steyling

Dr de Jongh prepared from the clinical reports of Dr Hulst, Dr Bok Dr Galema, Dr Dikkenberg Dr Droogleever Fortuyn, Dr Stolte, Dr Jonxis and Dr Soeters a concise appreciation of the clinical features of starvation chapter VI (b) The patho physiological and biochemical reports given in VI (d, and VI (e) 2 are based on appreciations prepared by Dr Stolte and Dr Hoogland covering the investigations of Dr Bok, Dr Hulst, Dr de Jongh and of their own group

The report of the investigations of the Test Ward laboratory Unit (VI e, 2) is based on a document prepared by Dr J Beattie Mrs Herbert and Dr Loutit whilst the account of the surveys of the Oxford Team (C) was drawn up by Dr Sinclair

The tribute to Dr J H Touw was contributed by Dr Bok who was Dr Touw's assistant during the war years

The volume of the manuscript made it necessary to relegate to appendices a very large number of tables and certain other material, if a readable volume was to be produced

It is the hope of the Committee that a large proportion of the medical and scientific data will be published in due course in appropriate journals by those who carried out the clinical and laboratory studies so that their interpretation of the findings can be put on record

The decision to compile the Report as essentially a factual document precluded any attempt by the Committee to analyse the findings as a whole and to base on them a final chapter giving their views and the conclusions to which these coul lead Nevertheless, there are a few general observations which are justified by every fact that is reported in the pages that follow These observations provide the substance of the short final chapter entitled General Conclusions

Perhaps the most striking impression carried away by those who attended the meetings at Brussels and Eindhoven in February 1945, when the original plans were drawn up for dealing with the rapidly deteriorating situation in Western Netherlands was the deplorable paucity of knowledge regarding the treatment of individuals suffering from grave starvation In living memory millions had died of starvation in catastrophic famines affecting the Far East and the U S S R

yet none of the experts who were consulted could say with assurance how such a famine should be met It was a grave challenge to social conscience and human responsibility a responsibility, which the Allied Governments accepted early in the war

The Editorial Committee would like to place on record how magnificent was the spirit that enthused those, who cooperated in helping to relieve the starving and under nourished people of the Western Netherlands It is easy to take for granted that effective and smooth cooperation in so vital and humane a mission follows as a matter of course But many hundreds of individuals were concerned and all were working at high pressure in an atmosphere of tension and of strain In spite of the conditions and the many formidable difficulties that had to be overcome, so often by crude and hasty improvisation, cooperation between all who took part in this achievement was smooth and happy

To acknowledge by name all who assisted in this historic event is impossible In Chapter VIII is given a long list of individuals whose invaluable help in one way or another made this report possible

Those who also helped but who are not mentioned by name, deserve no less the grateful thanks of all who shared or who benefited by their willing service in the cause of humanity

The Hague May 31st 1947

*The Editorial Committee*

G C E BURGER
J C DRUMMOND
H R SANDSTEAD

# IN MEMORY OF DR J F TOUW

On August 21st 1945 Dr J F Touw, specialist for Internal Diseases at Rotterdam South, died after having been ill for a few weeks at the age of 49

The physicians who were privileged to work with Dr Touw at Rotterdam to alleviate the misery in this town realize how great is the loss they suffered through his death The stream of letters that were received from colleagues of the Medical Feeding Teams testifies to the great appreciation of his person and his zest for work With complete disregard for himself, he devoted himself to the care of the starved people of Rotterdam Those who enjoyed the privilege of working with him during the years of the war, know how much he had suffering mankind during the war starvation at heart It was by his efforts that many months before the capitulation an organisation was called into existence under his direction, to aid the starving people in the quarter of Rotterdam South, an organisation consisting of an emergency hospital for about 200 patients and a polyclinic

Even at that time many people were saved from starvation by distribution of hidden food supplies How great was his distress when as the food reserves were reduced even this aid became inadequate He wanted to help but could not On the contrary, how great was his joy when the capitulation brought the possibility of rendering aid From that moment till the day of his illness, he exerted himself to the utmost to dispel starvation from the town in as short a time as possible and to bring food where it was needed most Nothing deterred him from putting all his energy into such a task In addition to his function as chief physician of the Southern Hospital he was leader of six emergency polyclinics a member of the I K B and a member of the Commission Emergency Supply He took the initiative in fighting down typhoid fever at Spijkenisse and afterwards at Rotterdam He was enthusiastic about the help he received from the Allied Authorities and from his countrymen who had already been liberated in attacking this problem

In addition to a great deal of social work he did Dr Touw found time to devote himself to the scientific questions that were raised by the starvation problem They held his attention and led him to suggest new ideas that he wished to see studied His mind was always busy he did not allow himself a moment's rest as long as he knew that work had still to be done Those who worked with him could rarely keep up pace with him

His life was a life devoted to thorough medical work His mind was always engaged upon medical problems The last eight months he devoted his activity to social work in a way for which Rotterdam cannot be too thankful

May he rest in peace

THE EDITORIAL COMMITTEE

## II FOOD AND HEALTH IN WESTERN NETHERLANDS BEFORE LIBERATION

### A DETERIORATION OF FOOD SITUATION [1]

Before the war the diets of the people of the Netherlands ensured a relatively good level of nutrition However the Netherlands were largely dependent upon imported food and foodstuffs, even to feed livestock for providing foods of high biological value (see table 1)

TABLE 1

| | Gross tons yearly figures, or annual averages | | |
|---|---|---|---|
| | Imports 1939—40 | Production 1939—'40 | Exports 1939 |
| Cereals | 1 715 000 | 1 294 000 | — |
| Oilseeds | 808 000 | 31 000 | — |
| Oilcakes | 639 000 | | — |
| Oil and fats for human consumption | 208 000 | | — |
| Butter | | 109 000 (1939) | 56 000 |
| Cheese | | 121 000 | 52 000 |
| Milk | | 5 412 000 | — |
| Milkproducts | | 164 000 | 184 000 |
| Meat (carcass) | | 411 000 | 42 000 |
| Eggs (million) | | 2 450 | 1 375 |

Importation of food ceased immediately after the German occupation in May 1940 but the reserve stocks had largely been consumed following the outbreak of hostilities in August 1939 After occupying the Netherlands the Germans proceeded to requisition large quantities of food for their forces and also exported large quantities to Germany Between May 1940 and September 1944, produce from about 60 % of the Dutch arable land was exported by the Germans after September 1944 the situation was obscure, but it is thought, that there was continued withdrawal of food by the enemy

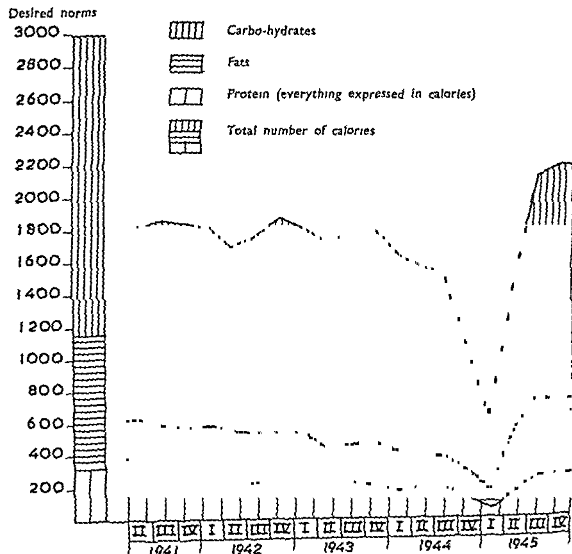
The adjustment to wartime conditions involved the ' breaking up" of much pasture land and the slaughter of large numbers of pigs and poultry By 1943 the area under potatoes had increased from 130 000 hectares (1939) to 210 000 hectares and that devoted to growing rapeseed from 3 000 to 50 000 hectares Agricultural production was hampered by decreasing supplies of fertilizer, particularly phosphates, and by increasing shortage of labor and farm machinery As a result the yield of cereals was reduced from 2 514 kg per hectare in 1940 to 1 449 kg in 1945 The corresponding decline in production of potatoes and sugarbeet was 21 859 to 15 044 kg per hectare Dairy production decreased as pasture land was used for cultivation of crops

[1]) Much information in this section has been taken from the report by Dr M J L Dols and D J A M van Arcken, Millbank Memorial Fund Quaterly 1946 Vol XXIV, no 4 p 319

An Office for the preparation of the Food Supply in Time of War had been established by the Government in 1937, so the basis of a rationing system was ready when hostilities broke out. Rationing of sugar was introduced in October 1939 and in June 1940 rationing was extended to include most of the chief foodstuffs (bread, rice, butter, meat, eggs etc.). Potatoes were rationed after April 1941; whole milk in August of that year and skimmed milk in September 1942.

*FIGS 1—3 show the total amounts of protein, fat and carbohydrates distributed during the whole war.*

*FIG 1. Course of the rationing in average quarterly figures of the foodstuffs distributed to persons with a normal consumption of food, expressed in the quantities of calories by means of protein, fats and carbo hydrates, supplied to the western parts of the Netherlands during the years 1941 up to 1945 inclusive*
*Desired norms according to Dr N v. EEKELEN and Prof Dr B. C P. JANSEN (Journal nutrition 1—15 Oct. '29)*

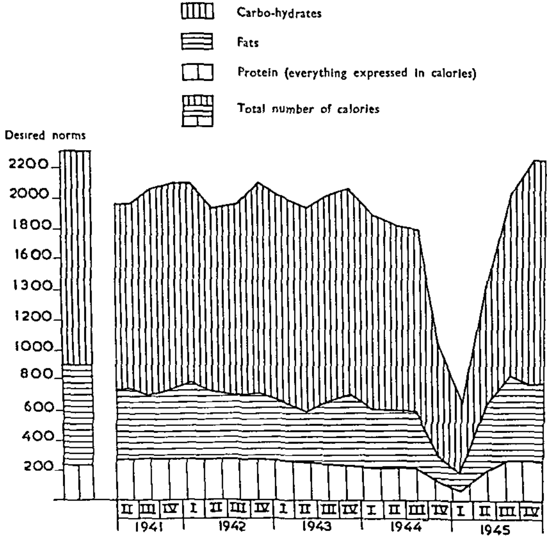



Derived from data supplied by the Board of Agriculture, Fishery and Food supply
Directorate of the Food supply Section Statistics

The rationing scheme was a differential one, based on the estimated requirements of the population groups, i e workers, children, expectant and nursing mothers etc The rationing was supplemented by a communal kitchen organisation Initially, coupons were surrendered for meals at these establishments but, later workers and schoolchildren were able to eat meals from the kitchens without surrendering coupons The kitchen system however, depended on the activity of local authorities

FIG 2 Course of the rationing in average quarterly figures of the foodstuffs distributed to persons of 4 to 14 years of age inclusive, expressed in the quantities of calories by means of protein, fats and carbo hydrates, supplied to the western parts of the Netherlands during the years 1941 up to 1945 inclusive

Desired norms according to Dr V v Eekelen and Prof Dr B C P Jansen (Journal Nutrition 1—13 Oct '39)



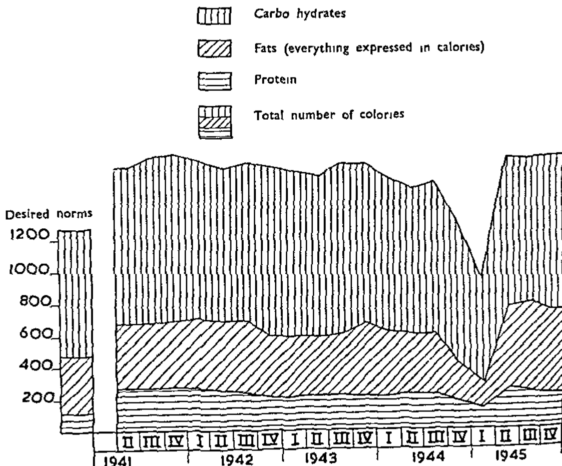

Derived from data supplied by the Board of Agriculture Fishery and Food supply Directorate of the Food supply Section Statistics

The rationing system worked reasonably well until September 1944 when the grave situation provoked by the railway strike changed the whole picture Prior to this the levels of calories and nutrients provided by the rations of the various groups of the population did not show wide variations There were occasional disturbances, as, for example, in May 1943, when the Germans witheld the butter ration for four weeks in retaliation for strikes that followed the deportation of former members of the Dutch armed forces as prisoners of war

Notwithstanding the favourable calorie supply, there was a considerable change in the composition of diets, the proportion of carbohydrates in the food rising Of the 3 423 000 calories supplied per head by means of the food distribution during the years 1940 until May 1945 about 12 % was supplied by protein (4 % being of animal origin) about 19 % by fat and about 69 % by carbohydrates

FIG 3 *Course of the rationing* of the distributed foodstuffs in average quarterly figures to children of 0—3 years old, expressed in the quantities of calories by means of protein, fats and carbo hydrates, supplied to the *western parts of the Netherlands during* the years 1941 up to 1945 inclusive

Desired norms according to Dr N v EEKELEN *and Prof* Dr B C P JANSEN (Journal Nutrition (1—15 Oct 29)




Derived from data supplied by the Board of Agriculture Fishery and Food supply Section Statistics

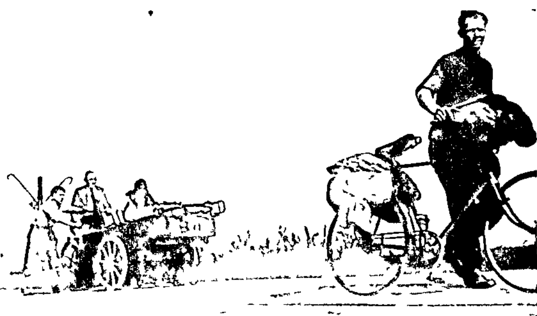


FIG 6

TABLE 2

TOTAL AMOUNTS OF FOOD CONSUMED

| | Period May 1940—1945 | Normal | Decrease |
|---|---|---|---|
| | kg | kg | kg |
| Protein | 100 (30 animal) | 200 (70 animal) | 100 (40 animal) |
| Fat | 72 | 153 | 81 |
| Carbohydrate | [illegible] | 825 | 237 |

Supplementing the rations clandestinely tended to increase the quantity of carbohydrates, extra fat and protein, especially animal protein, being very difficult to acquire

The extent to which people could supplement the rations varied a great deal with conditions It was much smaller in the towns than elsewhere and the poorer and elderly people could not benefit a great deal The general picture until September 1944, as reflected by the calorie equivalence of the rations, is shown in fig 4 and 5

T [illegible]

to Se [illegible]

C [illegible] railway strike and all Dutch railwaymen stopped work (see B B C Message on page 28 IIIa) Following the German embargo, prohibiting the transport of all food from the northern and eastern production areas to Western Holland that was imposed as a retaliation, a very grave situation was created The embargo was not relieved, *in spite of repeated appeals from Dutch authorities, such as the letter* from the Dutch medical profession (see Appendix No 2), until November 8th, when limited movement by water transport was authorised by the Germans

Before much could be done, cold weather made movement by water almost impossible and the foodsituation continued to deteriorate Stocks were rapidly depleted, in spite of a most careful distribution Sugarbeets were rationed and in some towns even tulip bulbs People went out as best they could from the towns into the countryside in search of food a few potatoes or sugarbeets (Fig 6) Anything that could be eaten was sought after Before long, the cold of the winter and the declining strength of the people made the search for food increasingly difficult Many died from exhaustion by the roadside The old, particularly, suffered badly

The Dutch Minister of Food supply urged the Government in London, directly after the attack near Arnhem in September 1944 and many times later, to send relief In January 1945 some food was sent by the Swedish Red Cross and from Switzerland Each person in the large towns was able to get about 400 grams of bread and 125 grams of butter a week from these supplies But in spite of this welcome help from neutral countries, the calorie equivalence of the people's food continued to fall It became no longer possible to give workers larger rations than those of the ordinary person, but, by means of emergency ration book a differential rationing of the age groups was maintained, in an effort to protect, as far as practicable, infants, young children and expectant and nursing women How miserable the situation became can be seen from fig 7, which gives the total calories,

2

FIG 4, 4*a*, 4*b* and 4*c* Composite curves showing calorie level of rations of under 1 year, 1—3 years, 4—13 years, 14—20 years and over 20 years from 1941 to October 1944

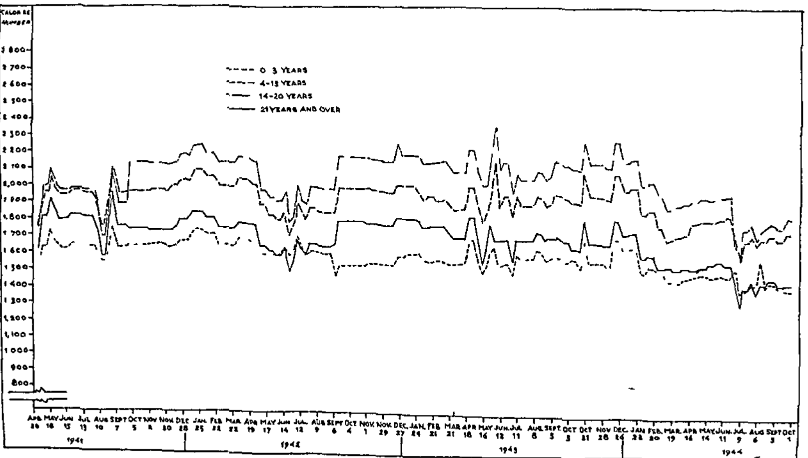
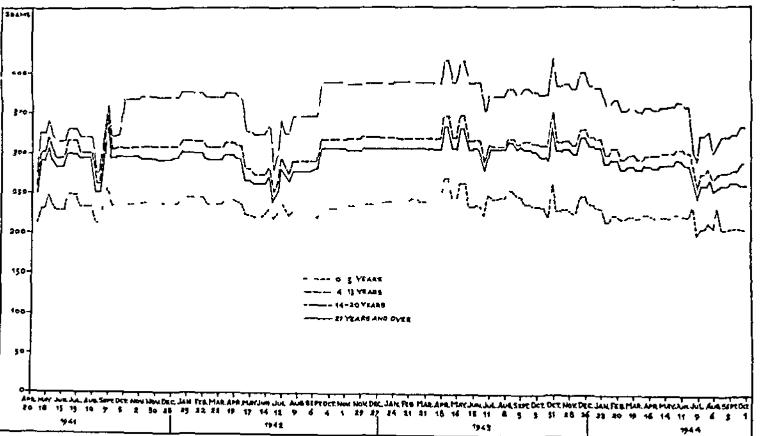



FIG 4 Calories per day in weekly food rations distributed throughout the Netherlands to different age groups from April 27, 1941 to October 1, 1944

FIG 4a Grams of carbohydrate per day in weekly food rations distributed throughout the Netherlands to different age groups from April 27, 1941 to October 1, 1944



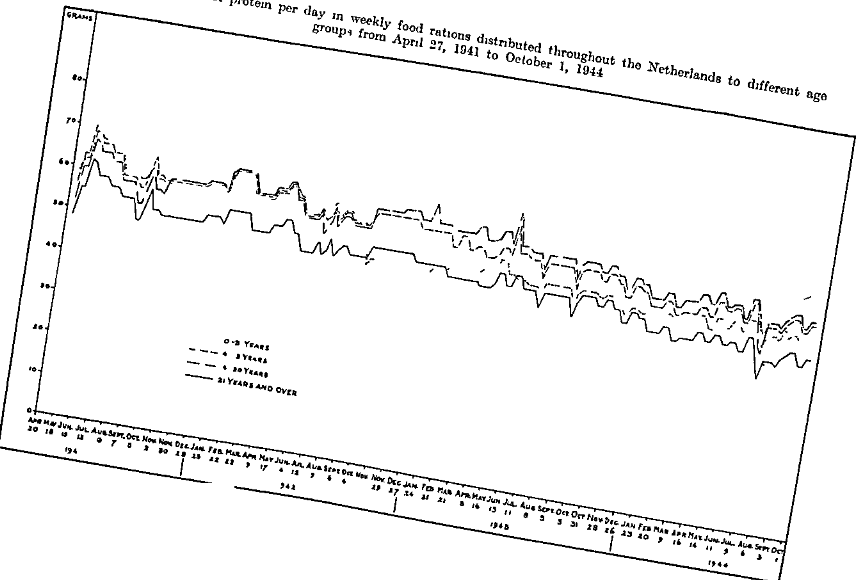



FIG 4b Grams of protein per day in weekly food rations distributed throughout the Netherlands to different age groups from April 27, 1941 to October 1, 1944

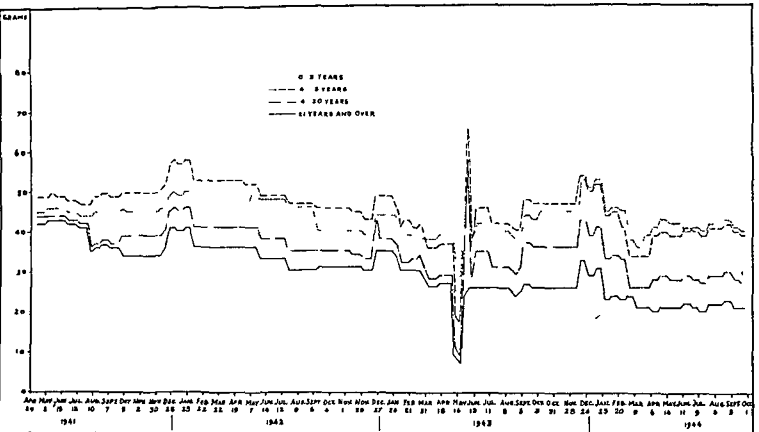



FIG 4c Grams of fat per day in weekly food rations distributed throughout the Netherlands to different age groups from April 27, 1941 to October 1, 1944

FIGS 5 5a 5b and 5c Composite curves showing calories level for the groups which received supplementary rations

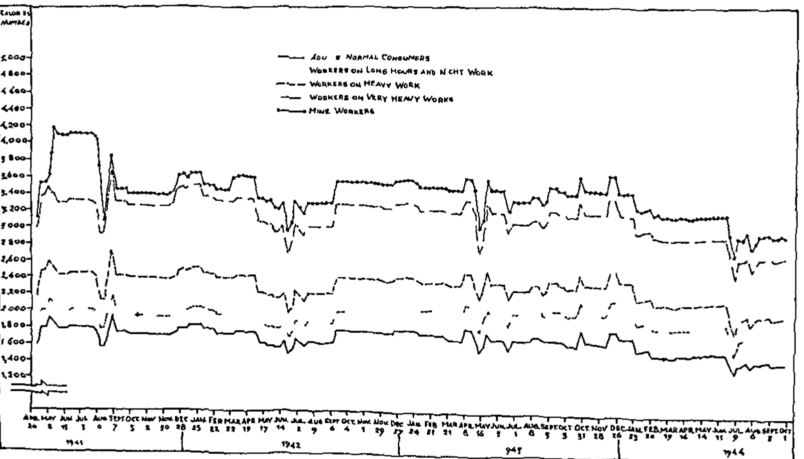



FIG 5 Calories per day in weekly food rations distributed throughout the Netherlands to adult normal consumers and to groups which received supplementary rations from April 27 1941 to October 1, 1944

FIG 5a Grams of carbohydrate per day in weekly *food rations* distributed throughout the Netherlands to adult normal consumers and to groups which received supplementary rations from April 27, 1941 to October 1, 1944

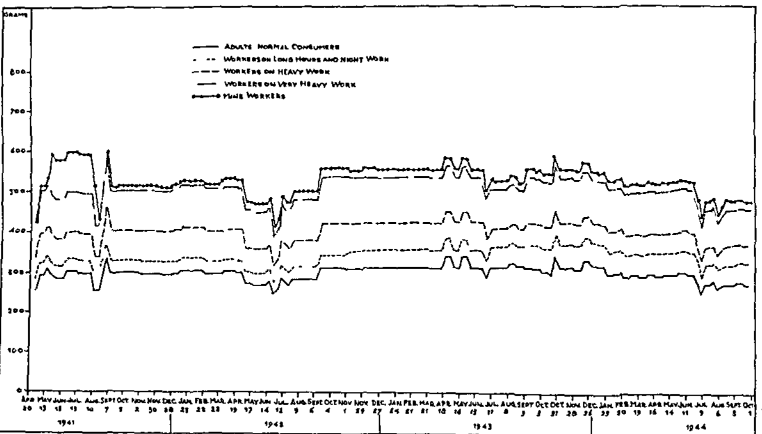


FIG 5b Grams of protein per day in weekly food rations distributed throughout the Netherlands to adult normal consumers and to groups which received *supplementary* rations from April 27, 1941 to October 1, 1944

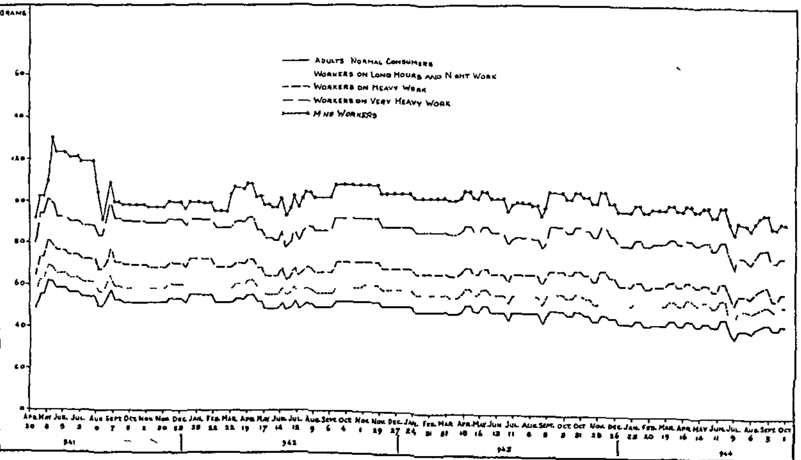


FIG 5c Grams of fat per day in weekly food rations distributed throughout the Netherlands to adult normal consumers and to groups which received supplementary rations from April 27 1941 to October 1 1944

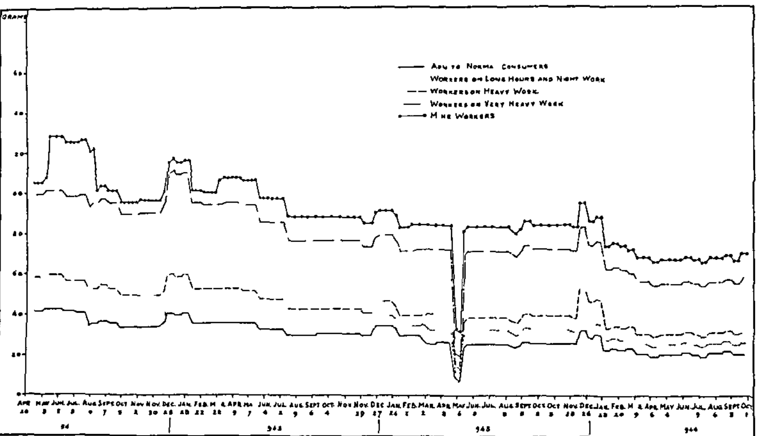
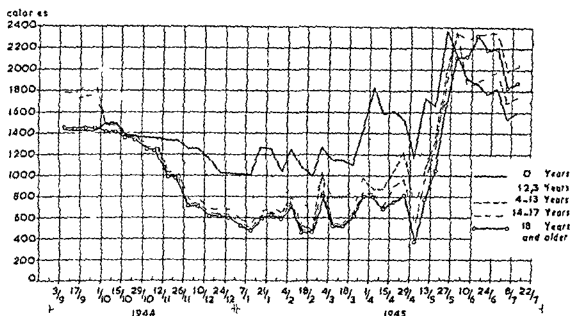


FIG 7 Total number of calories (exclusive of nonrationed items) daily distributed in Western Netherland weekly average Red Cross distributions and S H A F F supplies included 3 September 1944—15 July 1945




including all Red Cross Supplies

the different year groups are seen

about the difficulty in feeding chil

the food situation shows the overall picture in the Netherlands during World War II (table 3)

TABLE 3

| Pre war years | 1 000 000 cals per year |
|---|---|
| 1940 consumption was | 900 000 |
| 1941 | 685 000 |
| 1942 | 622 000 |
| 1943 | 622 000 |
| 1944 | 510 000 |
| 1945 | 568 000 |

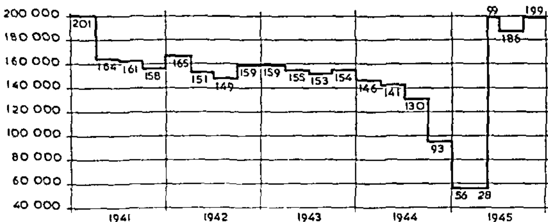
The consumption for 1945 showed slight improvement resulting from liberation in May 1945 The same data analysed in quarterly periods are shown in fig 8

This curve shows that rationing worked reasonably well until towards the end of 1944 Notwithstanding the help from the Red Cross the calorie value of the official rations had fallen to 400 a day in the larger Western cities by April 1945

It is not easy to estimate the vitamin content of the food during the period 1940—May 1945 The data are very uncertain The following figures are only approximate and refer primarily to the official rations

For *vitamin A* the daily amount per head went down from 1900 I U in 1940 to 900 in 1941, 400 in 1942, 350 in 1943 and 300 in 1944 to 150 in the first half of 1945 The amount of carotene was estimated as being between 2000 and 3000 units (expressed as vitamine A)

FIG. 8. Number of calories in the distribution parcel in every quarter of the years 1941—1945




The percentage of *vitamin D* in the food was very small and provitamin D must also have been present only in small quantities. To children, pregnant women and some other categories, such as tubercular subjects, cod liver oil, vitamin $D_2$ in tablets or for injection were supplied, on the whole in small quantities. Adults did not receive supplements.

*Vitamin $B_1$* was comparatively well supplied by the rations during the years before the crisis of 1944—1945. Up to that time the diet supplied at least 1 mg daily and often 1.2 mg. In the first four and a half months of 1945 the intake dropped to about 0.5 mg per day.

The amount of *Riboflavin* followed the same course: in 1940 and 1941 it was about 1.5 mg daily, in 1942, 1943 and 1944 slightly above 1 mg and in the last months of occupation only 0.35 mg daily.

There was fair amount of *nicotinic acid* in the food supplied by the rations: from 1940 to the end of 1944 the daily amount lay between 12 and 15 mg. In the latter months of occupation during 1945 it amounted to only about 5 mg daily. Bread of long extraction flour played a big part in maintaining a satisfactory intake of B vitamins until the scale of rations was drastically reduced.

The quantity pyridoxine (about 1.5—2 mg daily) was sufficient during the years 1940—1945. This was not the case in the bad months of 1945.

The supply of *folic acid* was probably sufficient. Whether this was also the case for *choline* is questionable; the supply of *pantothenic acid* was probably sufficient.

The supply of *vitamin C* in the rations, including vegetables, was fairly large except in the spring. Vitamin C in tablet form was obtainable. Because high extraction flour was used for making bread the percentage of *vitamin E* was probably higher than before the war. This also had a favourable influence upon the utilisation of vitamin A. As neither the percentage of tocopherol in many foods nor the need of this substance for man is known, we need not further go into this question.

The need for *vitamin K* derived from the food is unknown. Probably in most cases the intestinal flora are able to provide the quantity required, independently of the food. However the food supplied by the rations contained considerable quantities of this vitamin.

The percentage of minerals in the rations was sufficient on the whole, at least as far as *calcium* and *iron* were concerned The percentage of *calcium* was kept at a good level by the addition of 4 % calciumcarbonate to the flour during the period November 1942 to the end of 1944 After this it was low during some months For the percentage of *iron* a similar measure was unnecessary The percentage of *salt* in the food was fairly normal on the whole, except for the last 4 months when there was a serious shortage of salt

Notwithstanding the low vitamin levels in the food, especially in 1945, few clinical cases of specific vitamin deficiencies were seen (see clinical assessment chapter VI,c)

*On April 29th, the last ration of a kilogram of potatoes* and *400 grams* of bread was distributed There was no more food for distribution The first dropping of food supplies by R A F aircraft were made on May 1st, but because of the difficulty of collection and distribution some 10 days elapsed before it could be handed out to the people The most difficult week was the week of the official surrender when many persons had no food during the festivities of freedom Later the stocks that were moved in from the East became available and the situation steadily improved

## B DETERIORATION OF HEALTH IN THE WINTER 1944—1945

Until September 1944 the general health of the population was relatively good, although latterly there were signs that it was tending to deteriorate (see Pulse Committee Work in chapter VI, a) For example, the body weight decreased the tuberculosis morbidity increased and the appearance of the people was generally less robust

A serious deterioration of health, however, began after September 1944 especially in the Western Netherlands

The Pulse Committee gives few data that reflect the grave deterioration that set in soon after rations were drastically cut in the late autumn of 1944 On the other hand there is a mass of evidence to show, how rapid and how serious was the decline in physical condition and physical vigour as the winter progressed

Fall of bodyweight was progressive and rapid All the characteristic signs of calorie deficiency appeared undue fatigue on moderate exercise, feeling cold mental listlessness, apathy, obsession with thoughts of food etc (see chapter VI, c) In the beginning men especially were affected

It is easy to write now that each person got 400 calories a day In practice it was quite another thing Each Thursday there was published the list of the coupon numbers that were valid for the next weeks food One planned to divide that food over the week The ordinary person however, often consumed in two or three days all that was given for the whole week Consequently there was an enforced fast for 4 days until the next rations were available This seriously aggravated the situation People sought food everywhere in the streets and the surrounding countryside Anything edible was picked up in this way and they were lucky who found a potato or two or a handful of greens

In January 1945 the first cases of hunger oedema appeared and were admitted to the hospitals Soon the numbers multiplied Little relief could be offered these patients Even in the hospitals there was little food The nurses and physicians worked day and night without supplementary rations Their menu for example

was one slice of bread and one cup of tea substitute for breakfast, two potatoes, a little bit of vegetables and some watery sauce for lunch one or two slices of bread with a cup of coffee substitute and a plate of soup for dinner This soup was frequently made with sugarbeets by the Communal Kitchen For hospital patients however there was a little more food available so something could be done for them

In February however, so many came complaining of starvation, that the hospitals could not admit them all In several towns starvation hospitals were established With the aid of the underground forces schools were transferred into hospitals complete with beds blankets, sheets and other necessaries Food too, was brought in by the underground forces In spite of all these efforts enough beds could not be made available The patients admitted were treated until they were able to walk and then were discharged In many cases this remission was only temporary There was always a waiting list of patients waiting for admission and many of these were those who had been previously treated

In addition considerable help was given through polyclinics Those who had lost 25 % of their normal bodyweight received supplementary rations At the beginning of 1945 this amounted to 400 g of bread 500 g beans per day and some milk, when it was available Later on this supplement reduced to 400 g of bread alone and it was only given when the decrease of weight was as great as 35 % or 40 % too many people had reached the level of — 25 %

There was another means of providing supplementary calories During the early days of occupation an Interchurch Organisation (I K B ) was formed It gave invaluable aid to all victims of the occupation The I K B collected food from every possible source food sent to the Western Netherlands by individuals living in other provinces food collected from the better off families supplies from farmers The organisation was without official status and therefore trusted by the population The I K B made possible the provision of warm meals about 600 calories, to these who were in dire need At first meals were supplied on the recommendation of schoolmasters clergymen nurses and others later when no one could get extra food without a physician s certificate they were especially helpful to the polyclinics From a report by the late Dr Touw (Rotterdam) is quoted

The nutritional conditions became so serious during the last few months of occupation that distribution of extra food by the normal distribution organisation to patients, who were 25 % (later 33 %) underweight was authorised on approval of the controlling physicians As a result of the enormous numbers of patients, the cases could only be helped after a considerable lapse of time (2—3 weeks) with much dissatisfaction in consequence of this in a number of cases the special aid came too late This induced me (Dr Touw) to take over the work of the controlling physicians of the Municipality in co operation with alle the assistants and some family doctors The purpose of this Medical Committee was to try, to speed up the supply of extra food to the starving patients This attempt was succesful The food position however was deteriorating, coupons now and then could not be honoured Circumstances rapidly changed after liberation

„ In view of the large numbers of starving people these polyclinics for starvation patients were set up in several towns Here examinations were made using the „sacratama" formula (see chapter VI, a) the weights were taken and the patients inspected for oedema The urine was examined to differentiate hunger oedema from the frequently occuring nephritis Then necessitous patients received a coupon

for one meal per day from the I K B for two of three weeks If the patient was too ill to walk to the canteen, the meal was delivered to the home by volunteer helpers These volunteers were mostly children of about 14 years, because adults were in real danger of being „picked up" by the Germans for enforced work in the defence areas

There was little opportunity to collect data at these polyclinics because of pressure of work for example at Rotterdam 600 people were examined by 4 doctors each morning After liberation many more such polyclinics were set up (chapter V, c) When more food became available their aid became much more effective

In spite of this local organisation and effort, conditions became worse People dropped from exhaustion in the streets and many died there Often people were so fatigued that they were unable to return home, before curfew, so they hid in barns or elsewhere to sleep and there died Older people, who lacked the strength to go searching for food, stayed at home in bed and died The worst cases were hidden in the homes and being unknown to the physicians could not be treated

Famine took its course with all its consequences Vermin became common there was no soap frequently there was no water, gas or electricity Many people had skin infections and frequently abscesses and phlegmones

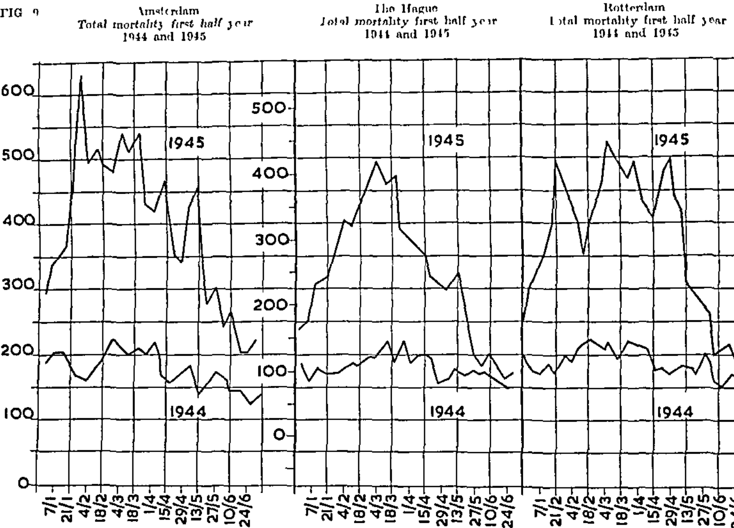
The exact number of hunger oedema patients is unknown Only an estimate can be made from data from some of the large towns In May 1945 some 200 000 cases required additional food (see V, c, d and e) The very serious situation is well illustrated by the following graphs, showing the numbers of deaths in the three great cities Amsterdam Rotterdam and the Hague (fig 9) Detailed mortality is discussed on page 24 at the end of chapter II c

Even during this critical period the nutritional conditions of the infants remained relatively good, there being sufficient food for their bare maintenance Only in those cases starved infants were found, where the parents were asocial and sold the coupons of the infants The greatest difficulties were caused by lack of heating clothing and soap

Proper care for patients was out of the question Even when gas and electricity were available, they could be used only for short periods each day Latterly these services were not available at all All hospital and laboratory supplies, drugs, disinfectants, instruments, films became almost unobtainable as supplies were used up Medicine had virtually returned to the days of primitive bedside methods

From the medical point of view starvation symptoms were not the only difficulties All starvation cases were sent to the starvation hospitals, other hospitals admitted the ordinary sick It was impossible to treat all known diabetics with the insulin dose, they had received in prewar times It was expected, there would be a number of deaths from diabetic coma as some patients were taken entirely off insulin, but this end of the disease was seldom seen Sulfa drugs were extremely rare This handicapped the normal therapy of infections Considerable difficulty was experienced due to the lack of disinfectants, needed so badly during the frequently occurring epidemics of dysentery and typhoid fever In some rural areas waterborn typhoid fever was occurring In a few areas large scale epidemics of typhoid and paratyphoid occured (Spykenisse and Gorinchem) In Spykenisse where water could not be sterilised large numbers of people were affected and the out break could only be checked when the Allies came

FIG 9


Amsterdam
Total mortality first half year
1944 and 1945
The Hague
Total mortality first half year
1944 and 1945
Rotterdam
Total mortality first half year
1944 and 1945
1945
1944
600
500
400
300
200
100
0
7/1
21/1
4/2
18/2
4/3
18/3
1/4
15/4
29/4
13/5
27/5
10/6
24/6
21/2

Because of lack of fuel, several families would frequently move into one home creating conditions favourable to epidemics Individuals and gangs broke in into the evacuated houses, carrying off fittings, woodwork and furniture for fuel Even the waiting room of the Rotterdam South railway station was looted one night! Casualties were caused several times during such raids from walls collapsing

In the early spring of 1945 hospitals were without electricity and there were no candles, oil or carbide lamps New admissions at night could not be examined until the following day The operating theatre could not be used until sunrise Instruments had to be sterilised over a common stove Occasionally there was neither water nor heat in the operating theatre Only emergency surgery was performed because of the danger of „cold shock

Notwithstanding these conditions much work was done by the hospital authorities to keep mortality as low as possible The will and capacity of the staff remained excellent it only was a lack of materials that made prevention and treatment of disease difficult

## C MORTALITY STATISTICS

General mortality statistics of the Netherlands show (fig 10) a fairly regular decrease from 1871 to 1938 with an increase during World war I Immediately after the beginning of World war II a second rise appeared [1])

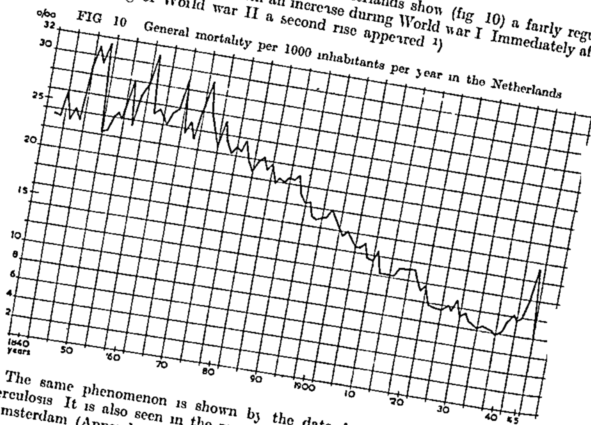



FIG 10 General mortality per 1000 inhabitants per year in the Netherlands

The same phenomenon is shown by the data for infant mortality and for tuberculosis It is also seen in the records for tuberculosis mortality for the city of Amsterdam (Appendix No 4)

[1]) That the mortality curve showed a sharper peak in the Western Netherlands only is shown in chapter IX by Dr BANNING

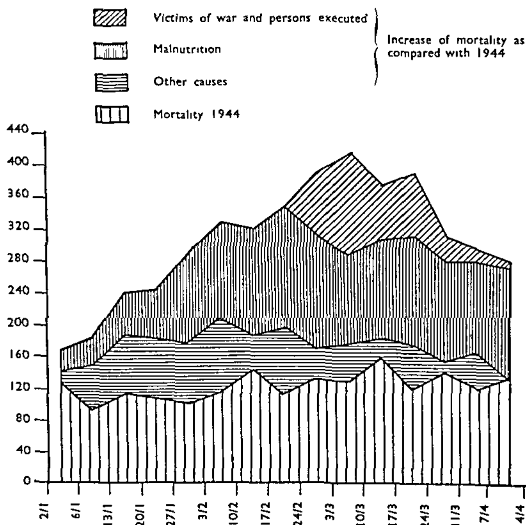
The relative increase in mortality for the years 1940—1944 is shown in table 4

TABLE 4 RELATIVE INCREASE IN PERCENTS OF THE 1939 MORTALITY

| | 1940 | 1944 |
|---|---|---|
| General mortality | 14 | 21 |
| General mortality (without war victims) | 8 | |
| Infant mortality | 16 | 22 |
| Tuberculosis mortality | 9 | 88 |

The greatest rise in mortality, however took place in the winter 1944—45 in Western Holland. This is shown in figures 11, 12 and 13.

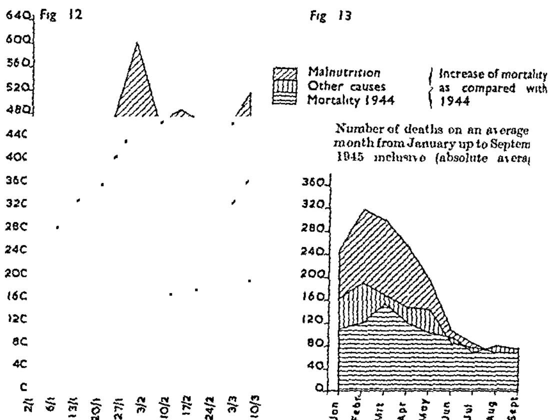
FIG. 11. Mortality at The Hague from January 2 up to April 14th 1945 inclusive as compared with the same period in 1944.
Number of deaths per week from 3 January up to 14 April inclusive (absolute numbers)




3

FIG 12 Mortality in Amsterdam from January 1st up to March 10th 1945 inclusive, as compared with the corresponding period in 1944

FIG 13 Mortality at The Hague from January up to September 1945 inclusive, as compared with the corresponding period in 1944




In these figures, the middle and lower components (▥ and ▤) are compris of cases, where the cause of death was registered under diagnoses other than starvatio The middle group (▥) represents the increase of this mortality over that of 194 Since starvation will have had an adverse influence on the course of a numb of diseases, it will have contributed to the higher mortality from these diseas

The general mortality in four cities is given in table 5

TABLE 5 NUMBER OF DEATHS IN 4 CITIES IN WESTERN HOLLAND

| City | Population | Number of deaths in the first 6 months of | | | Relative mortality | | | Number of death per 1000 inhabitan calculated as mo tality in one yea | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1939 | 1944 | 1945 | 1939 | 1944 | 1945 | 1939 | 1944 | 194 |
| Amsterdam | 800 000 | 3655 | 4393 | 9735 | 100 | 120,2 | 266,3 | 9 2 | 11,3 | 25 2 |
| Rotterdam | 640 000 | 2616 | 3260 | 7827 | 100 | 124 6 | 299 2 | 8,5 | 10,7 | 25 8 |
| The Hague | 520 000 | 2419 | 2940 | 6458 | 100 | 121,5 | 267,0 | 9,7 | 13 0 | 25 7 |
| Utrecht | 170 000 | 776 | 1112 | 2065 | 100 | 143 2 | 266 1 | 9 3 | 13 0 | 24 3 |

*From these figures it is seen that mortality had risen above the general mortality of the year 1840 (27 ‰)* (See also chapter IX Dr BANNING)
The highest mortality observed in one week in 1945 was (table 6)

TABLE 6

| City | Week of highest mortality | Mortality |
|---|---|---|
| Amsterdam | 29/1— 4/2 | 42 ‰ |
| Rotterdam | 12/3—18/3 | 41 ‰ |
| The Hague | 19/2—25/2 | 39 ‰ |

# III PREPARATION FOR RELIEF

## A ORGANISATION OF ALLIED RELIEF

This Section deals with the organisation, functions and plans of the Public Health Branch of the Netherlands Military Administration (N M A ) and the Public Health Branch of the Supreme Headquarters Allied Expeditionary Force (S H A E F ) Mission to the Netherlands in so far as they were concerned in providing relief for the starving people of the Western Netherlands

In the fall of 1943 medical officers of the Dutch Government who were in exile were incorporated into the Netherlands Military Administration, for the purpose of forming a Public Health Section The Public Health Branch of the S H A E F Mission to the Netherlands was set up in March of 1944 These two groups were formed in order to make the necessary preparations in the field of public health and medical services for civilian relief and to relieve the military authorities of civilian commitments Both of these groups arrived in the Southern Netherlands in September 1944 and established headquarters at Eindhoven, where plans for the relief of enemy occupied Netherlands were made in close collaboration with the civilian health authorities

A directive from the Public Health Branch of the Supreme Headquarters G 5 issued early in 1945 made the health officer of each Allied Mission directly responsible for reporting the nutritional status of the civilian population This directive indicated the form to be followed in making up these reports and it also contained suggestions for conducting surveys

In the early days, after Eindhoven and Nijmegen were liberated, it was confidently expected that the Allied Armies would sweep on to the North Sea On September 17th, 1944, the heroic air borne attack on Arnhem was launched as the spearhead of a drive that, it was hoped, would carry the Allied advance across the Neder Rhine On the same day, Professor GERBRANDY, Prime Minister of the Netherlands Government Exiled in London authorised an appeal through the British Broadcasting Corporation to the Dutch people to hamper the movements of the enemy by a railway strike Almost every home in occupied Holland had its hidden wireless receiver, by which the following historic message came to the people

,,After having received instructions from Headquarters in the Netherlands and after careful consideration, the Government considers it the right time to give their orders for a general strike to Railway personnel, to prevent hostile traffic and troop concentrations as much as possible in connection with military activities just started in Holland

The Government realises the serious responsibility it is assuming, but after careful consideration of the circumstances, the decision to give this order is of such military importance, that it can no longer be postponed

The Government being fully aware of the difficulties this order will cau lets the way it is executed to your tact and wishes you all, faithful and br countrymen, the strength to fulfill this action to the best of your ability '

The whole hearted response of the Dutch railway services paralysed movements over the whole occupied country

Unfortunately, the great attack at Arnhem was a heroic failure which

to a temporary but serious check to the Allied advance Meanwhile the Reich's Kommissar SEYSS INQUART informed the Dutch Secretary General of the Ministry of Agriculture and Director General of Food Supplies that a famine would be bound to follow if the railways were not freely operated again The Dutch gallantly held their ground and so faced the embargo on the movement of food from the northern and eastern occupied areas that SEYSS INQUART threatened to and did in fact impose as a retaliation

From that moment the situation in the West rapidly deteriorated there being but small stocks of staple foods

In December 1944 Dr C VAN DEN BERG Director General of Public Health of the Netherlands brought to the attention of his Government in London the very grave consequences of food shortage that would affect the people of the occupied territory, if liberation did not come before the spring of 1945 He was asked by the Prime Minister Professor GERBRANDY to make a report on the subject and did so on December 29th

The first reports that the nutritional state of the people in the West and Northwest Netherlands was becoming desperate, began to filter through the Allied lines in January 1945 These reports varied with the informant and in some instances were obviously exaggerated Nevertheless an analysis of a steadily increasing number of reports coming in from many sources gave definite indications that there was urgent need to prepare large scale special relief measure

On January 16th and 17th meetings were held in Eindhoven with civilian health authorities public health section of S H A E F and N M A and three visiting Allied nutrition experts Col V P SYDENSTRICKER U S Public Health Service Col PAUL HOWE Chief Nutritionist Supreme Headquarters G 5 and Sir JACK DRUMMOND regarding the planning of appropiate relief for the starving people

Further talks were held in London on the 27th and 30th of January when Dr V D BERG Director General of Health of the Dutch Government was able to discuss the matter with Sir J DRUMMOND and to get the views of Prof H P HIMSWORTH representing the British Medical Research Council and of Dr C LEACH of the Rockefeller Foundation who had had personal experience of starvation conditions when a prisoner in Japanese hands in the Far East

These preliminary discussions led to a meeting being called by S H A E F Mission This was held at Brussels with Brigadier A DE L CAZENOVE in the Chair This conference was attended by senior Officers of S H A E F 21st Army Group and N M A and by a group of public health and nutrition experts called in for advice (see Appendix No 5)

The types and quantities of foods that had been stockpiled for distribution in the B. area (the Western Netherlands) were reviewed in the light of the summary of intelligence reports Another aspect of the problem had also to be carefully considered It was thought not unlikely that the Germans would deliberately flood large areas of the West and thereby precipitate a terrible catastrophe

The Conference reached the conclusions that immediate steps should be taken to organise special provision of foods and other materials suitable for dealing with seriously undernourished and starving people It was also decided to organise with the co operation of the Dutch Red Cross special mobile teams of doctors and trained personnel to handle the treatment of those suffering from severe starvation

It must be emphasised that very little of a definite nature was known about the treatment of such cases. The severe famine in India 1943—44 had provided some evidence that those moribund from the effects of starvation, could be succesfully treated by the intravenous administration of predigested protein. The number of cases treated was not large, and for this and other reasons the evidence was not regarded as convincing.

The Conference agreed, therefore, to make two assumptions, both of which were proved to be wrong in the light of experience gained three months later.

The first assumption was that many seriously starved individuals cannot swallow food, even liquids. Materials for intravenous injection or administration by nasal tube should, therefore, be provided.

The second assumption was that the ability to digest food is very seriously reduced, if not absent, in such patients. It would be necessary, therefore, to provide predigested protein foods and simple substances such as glucose. Accordingly, a Committee was set up with authority to supervise the preparation of supplies of predigested protein, both for intravenous and oral administration, serum for intravenous use, glucose with added vitamins and any other special foods thought to be necessary.

After the Brussels Conference another was held at Eindhoven the next day, at which Col. SANDSTEAD, Dr. BURGER and the nutrition experts called in by S.H.A.E.F. and 21st Army Group, conferred with the Dutch Advisory Committee[1]) under the chairmanship of Dr. VEEGER, Deputy Chief Inspector of Public Health. Plans for the special feeding and for organising the medical feeding teams were laid before that Committee and met with their approval.

Immediately after these Conferences meetings of experts were held in London under the auspices of the Protein Requirements Committee of the Medical Research Council, at which arrangements were put in hand for the manufacture and packing of the requisite materials by the Ministries of Food and Supply. A brief description of the special "packs" is given on page 38. This special provision was given the name "F treatment".

On April 6th the Advisory Committee met officers of S.H.A.E.F. Netherlands Mission, 21st Army Group and N.M.A. at Eindhoven to review progress.

Accumulated Intelligence reports from the occupied area and first hand evidence from Netherlanders who had recently come through the lines were reviewed. It was clear that the situation in the large towns was desperate. Rations for the ordinary consumers had fallen to the grave starvation level of about 400 calories a day, the incidence of hunger oedema was rising sharply, adults were too weak to work, there were many sudden deaths from exhaustion in the streets, and both the death rate and the infant death rate were alarmingly high. People were eating any kind of food they could acquire, including tulip bulbs.

It was provisionally estimated, that there might be 400 000 of the population of the Western towns in urgent need of special care, of whom 30 000 might be in the last stages of starvation.

The Dutch reported that their preparation of relief measures was well advanced. Fifty-one medical feeding teams had been recruited. Of these twenty-five had been

[1]) The Dutch Advisory Committee consisted of Dr. VEEGER (President), Dr. VAN BUCHE… Dr. BURGER, Dr. KEIZER, Dr. SLOOFF.

trained for their special work and the remainder were in course of training The British reported that the manufacturers of the protein hydrolysate had completed in a remarkably short time the 400 special packs with which to equip the medical feeding teams for treating 20 000 bad cases for 3 days More supplies were being got ready

The British also reported that intensive efforts had been made by the Ministry of Food, to obtain all available supplies of milk (canned or dried) in order to provide the very large quantity, that would be required, to feed children and those whose condition was not extreme

As it was doubted whether the Dutch physicians of the towns to be liberated would be physically able to handle the grave emergency, arrangements were made through the Netherlands District and 21st Army Group to bring in 100 British and 200 Belgian senior medical students if the need for them should arise As events proved it was not found necessary to call on these reserves

In order rapidly to assess the nutritional situation on liberation, three nutrition survey teams were assigned by Supreme Headquarters G 5 Public Health Branch, to the S H A E F Mission (Netherlands) These teams consisted of Wing Commander J F Mc Greary and Squadron Leader H D Branion of the Royal Canadian Air Force Major M B Corlette[1]) Dr Frederick Stare and Captain Cyrus French of the Surgeon General's Office of the U S Army and a third led by Dr Hugh Sinclair of the Oxford Nutrition Survey

The nutrition teams were set up to make two kinds of appraisal one being a rapid survey of the urban population to determine the number of people requiring special feeding and hospitalisation and the other a more detailed study of the nutritional picture on which to base the main feeding plans

As very little was then known about the efficacy of treatment of severe starvation, it was thought prudent to have facilities for making appropriate laboratory studies Accordingly, a laboratory unit was organised by Dr J Beattie with the co operation of the Scientific Staff of N V Organon Oss Dr Tausk, Scientific Director of that organisation willingly put a laboratory and members of his staff at Dr Beattie's disposal Preparation for scientific work was begun there in early April 1945 Another unit was also prepared with a view to establishing as soon as the Allied Advance made it feasible a hospital Test ward where special cases could be treated and studied This unit was put in charge of Dr S Galama

Arrangements were then made for the Oxford Nutrition Survey's two mobile laboratories to be shipped with the least possible delay to Holland Unfortulately, owing to shipping difficulties the laboratories did not arrive until May 24th, but from May 8th Dr Sinclair was able to assist in other survey work then in progress

At the end of April the situation was as follows

1 The *Nutritional Advisory Committee* was supervising the preparation of all special feeding measures Its membership was

| | |
|---|---|
| Lt Col J A F van den Belt | N M A Public Health |
| Dr J Beattie | Royal College of Surgeons |
| Dr G C E Burger | Deputy Inspector of Health (Netherlands) |
| Sir Jack Drummond (President) | British Ministry of Food |
| Dr C Leach | Rockefeller Foundation |

[1]) Maj Corlette recalled by S H A E F Mission about May 10

Dr J F LOUTIT [1]) British Medical Research Council
Lt Col H P SANDSTEAD S H A E F Public Health G 5
Col V P SYDENSTRICKER U S Public Health Service

2 Supplies of special and other foods had been prepared and were ready at appropriate points behind the Allied lines

3 The Advisory Committee was standing by at Ellecom

4 Fifty one specially trained feeding teams were standing by ready to move into action when called forward One advanced echelon was situated at Ellecom with second and third echelons at Grave and at the base of Breda These teams carried supplies of food for emergency treatment (see chapter III, b)

5 The S H A E F and R C A F Nutrition survey teams were ready to move forward to make assessments of the situation in towns immediately after liberation While waiting to be called forward they made nutritional surveys in the newly liberated area, e g at Velp and Arnhem

6 The laboratory group located at Oss was carrying out preparatory work to simplify their task when the advance began

The inter relation of the units individuals is set out in table 7

In the plan devised for bringing this organisation into action three phases were foreseen

*Phase 1 Reconnaissance* As soon as possible after the Allied Forces advanced, survey teams A and B of R C A F and S H A E F would enter towns or villages and rapidly make assessments of the nutritional situation If it called for special treatment, units from the forward echelon of medical feeding teams would be called forward, replacements would move up from the South Medical members of the Advisory Committee would accompany the forward echelon of feeding teams

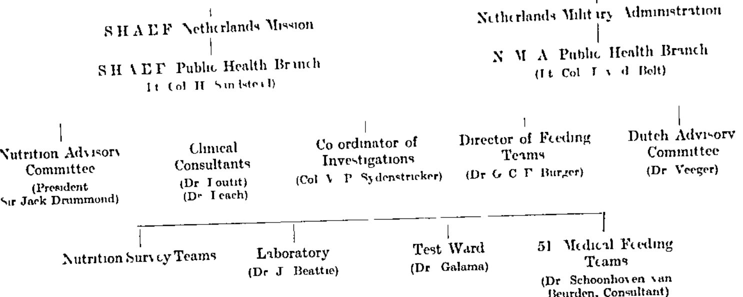
*Phase 2 Infiltration* A considerable area having been liberated, with a number of feeding teams in action and the survey teams still advancing with the spearhead, a suitable location would be found at which to establish the experimental test ward Dr GALAMA and Dr BEATTIE would set up their unit and the H Q of the Advisory Committee would also move from Ellecom to that place Laboratory work would be done at Oss

*Phase 3 Consolidation* On completion of liberation, the testward would move to a large town, if not already in one The laboratory would move there, if the necessary facilities could be found The H Q would also be moved there The survey teams would then begin their more detailed investigations having completed the rapid preliminary assessment of the nutritional picture

During the period of waiting for the Allied Army to advance, opportunities arose for studying the value of protein hydrolysates in severe starvation A mental institution was uncovered at Warnsveld, near Zutphen where many of the inmates were found to be in a state of extreme emaciation from lack of food A nutritional survey was made and cases were treated with protein hydrolysate orally and intravenously There was not time to make a thorough study before orders came to the relief organisation to move to the West, but preliminary trials, supervised by Dr V P SYDENSTRICKER were encouraging

[1]) Dr LOUTIT replaced Prof H P HIMSWORTH as representative of the Medical Research Council when he had to relinquish his membership of the Committee in March because of illness

TABLE 7



G 5 S H A E F 21st Army Group, Netherlands District
S H A E F Netherlands Mission
S H A E F Public Health Branch
Lt Col H Smidstedt)
Netherlands Military Administration
N M A Public Health Branch
(Lt Col J v d Belt)
Nutrition Advisory Committee
(President Sir Jack Drummond)
Clinical Consultants
(Dr Loutit)
(Dr Leach)
Co ordinator of Investigations
(Col V P Sydenstricker)
Director of Feeding Teams
(Dr G C F Burger)
Dutch Advisory Committee
(Dr Veeger)
Nutrition Survey Teams
Laboratory
(Dr J Beattie)
Test Ward
(Dr Galama)
51 Medical Feeding Teams
(Dr Schoonhoven van Beurden, Consultant)
A R C A F (Wing Comdr J F Mc Creary)
S/L H D Branion
B S H A E F (Maj M B Corlette
Dr F J Stare
Capt C French
C Oxford (Dr H Sinclair)

A second opportunity was provided by the liberation of the German "horror camp" at Bergen Belsen in April Dr SYDENSTRICKER and Dr LEACH were called there by 21st Army Group and Sir JACK DRUMMOND followed some days later, Some of the extremely emaciated victims of the Germans were given protein hydrolysates in an effort to dispel hunger oedema and resuscitate them but, again there was no time to make a proper investigation before orders came, that predicted the long expected move to the West Later, the study was continued at Belsen by Dr JANET VAUGHAN of the Medical Research Council and Dr P MEIKLEJOHN of U N R R A , with results that did not support the optimistic views that had been held about the value of protein hydrolysates

The Dutch Advisory Committee had taken the opportunity to study the value of protein hydrolysates in treating marasmus in babies in hospitals at Eindhoven and Tilburg (Dr SLOOFF and Dr KEYSER) Their reports were so discouraging that it led them to decide against attempting to use this form of treatment for babies Arrangements were, therefore, made to carry larger supplies of appropriate infant foods, when the medical feeding teams moved forward

These preliminary trials were of great importance, because although they were by no means adequate, they strongly indicated that protein hydrolysates could not be relied upon as the mainstay of the treatment of very severe cases of starvation Fortunately the impressions gained from these investigations enabled plans to be reviewed, so that much larger quantities of milk and infant foods could be taken in to the Western areas by the medical feeding teams and supply units than had formerly been provided

A decision to cut drastically the further manufacture of the protein hydrolysate glucose vitamin pack was taken at a meeting at the British Ministry of Supply on May 18th Alternative methods of feeding undernourished people were then dominating the picture

## B ORGANISATION OF MEDICAL FEEDING TEAMS

The Medical Feeding Teams were formed as a part of the Dutch Red Cross Help Corps (N R X H , under the command of Lt Col LAMAN TRIP) The composition of each team was as follows 1 physician, 1 head nurse, 5 nurses or assistant nurses, 5 social workers, 2 drivers and 1 administrator Altogether 51 such teams were formed The composition of the "Testward" was as follows 4 physicians (2 internal specialists, 1 general practioner, 1 pediatrician), 3 headnurses, 17 nurses, 5 social workers, 1 dietetician, 1 administrator, 1 cook and 2 assistants

The recruiting of volunteers from the liberated provinces (Limburg, Noord Brabant and Zeeland) was established under Sections VIII, Public Health and XIII, Social Welfare of the N M A

The teams were assembled, trained and equipped in the Red Cross Training Camp A week s training was given to each Medical Feeding Team by Dr WASZINK The scheme of training is given in Appendix No 6

On 8 April 1945, Dr G C E BURGER was placed in charge, and in this capacity joined Section VIII (Public Health) N M A The staff consisted of the following

Dr G C E BURGER — General Director
Dr A J R E v SCHOONHOVEN VAN BEURDEN Major — Director of Medical Work

| | |
|---|---|
| Dr H. WASZINK Captain | Recruiting training equipment |
| Dr COHEN Captain | Liaison Section VIII |
| Dr K. VERDAM Captain | Liaison Directorate Emergency Supply |
| Mrs E. v. DIJK physician | |
| Dr J. JAGER physician | |
| C. A. TH. M. HOOGENBOSCH dental surgeon | Supply Officer |
| Nurse GROENHART | Head Nurse |
| S. TOUWEN | Secretary |

In view of the necessity of rendering early aid and of the greatly specialised medical task the commander of N R N H agreed that a great measure of independence should be given to the Feeding Teams Only for matters of a general disciplinary personal and financial nature was Section XIII to be consulted

The preparation and training of the teams were based on the idea, that inpatient treatment would be with protein hydrolysate feeding It was realised however, that this clinical treatment would not provide a complete solution for the problem of treating seriously starved people and that while a few days specialised clinical treatment might be life saving provision had to be made to supply the convalescents with light digestible diets for a considerable time Moreover if the estimate of 10 % seriously starved people i e 400 000 persons was only approximately correct, steps had to be taken to treat those cases not severe enough for admission to hospital

The following plans were made

I Clinical trial of protein hydrolysate

*a* in infants

*b* in adults

II The provision of supplies recognised foods for combating famine i e nourishing light digestible foods (milk farinaceous foods etc )

III The provision of special foods for infants and children

Although an approximate number of starved people to be dealt with, was known no reliable information could be obtained from the intelligence services about the complete clinical and epidemiological picture Thus there was doubt as to relative numbers of infants children aged etc to be treated and as to the *types of conditions to be treated*

A preliminary clinical trial of protein hydrolysate in infants was made in the hospitals at Eindhoven and Tilburg by Drs SLOOFF and KEYZER The results were discouraging Preparations were therefore made for the Feeding Teams to carry extra supplies of suitable babyfoods which were ordered from the Commission of Emergency Supply (Appendix No 7)

Another preliminary clinical trial but in adults was made by Prof SYDENSTRICKER Drs SCHOONHOVEN VAN BEURDEN and GALEMA at Warnsveld The results indicated

I that is was unjustifiable to provide Feeding Teams only with hydrolysate an intolerance of hydrolysate by some patients had to be considered

II that for scientific reasons several different methods of treatment should be compared only thus could the value of hydrolysate be assessed

The hydrolysate units comprised the following

a *Intravenous treatment* (for the treatment of four persons)

| | |
|---|---|
| 5 % Hydrolysate Solution | 10 × 1 pint bottles |
| Dried serum or plasma | 5 bottles |
| 10 % glucose solution in pyrogen free water | 5 (16 Oz size) |
| Intravenous giving sets | 4 |
| Glucose vitamin mixture | 875 grammes |
| Instruction Sheets | 3 |
| Record Cards | 12 |

b *Oral treatment* (for treatment of 16 persons)

| | |
|---|---|
| Protein hydrolysates | 2 4 kilos |
| Glucose Vitamin Mixture | 10 |
| Household Milk Powder | 10 lb |
| Bottles (transfusion type) | 4 |
| Gastric drip giving sets | 4 |
| Instruction Sheets | 2 |
| Record Cards | 24 |
| 5 nails | 4 |
| Adhesive Tape | 1 roll |
| 25 grammes Scoops | 3 |
| Lubricant | 1 carton |

The composition of the Glucose Vitamin Mixture used in both the oral and intravenous treatments was as follows

| | |
|---|---|
| Citric Acid | 15 grammes |
| Vitamin B 1 (Aneurine) | 13 3 milligrammes |
| B 2 (Riboflavine) | 13 3 |
| Nicotinamide | 133 3 |
| Vitamin C (Ascorbic Acid) | 333 3 , |
| Glucose | sufficient to make 1 kg of Mixture |

The Citric Acid was added both as a flavouring agent and as a protection for the vitamins

Early in April 1945 the first units of both oral and intravenous hydrolysates were on their way to Holland by air and increasing numbers soon after Fig 14 and 15 show the unit case and its contents

## D SHAEF AND 21ST ARMY FOOD SUPPLY PLANS

In planning for the feeding of the Western Netherlands 4 2 million population the groups were guided by the recommendation of the Inter Allied Post War Requirements Bureau

In 1943 there had been set up in London the Inter Allied Post War Requirements Bureau charged with the task of estimating the needs of Western European countries for food and other materials when liberated Representatives of Allied Governments temporarily in England assisted to reach decisions at these important discussions One Committee under the chairmanship of Dr PENROSE of the US State Departement and vice chairman Sir JACK DRUMMOND Ministry of Food




FIG 14 Portable pack special emergency foods for treating severe starvation cases This figure shows in front left to right 3 tins glucose with added vitamins (see page 38) 10 tins separated milk powder 3 nasal drip sets 3 scoops adhesive tape nails 10 tins separated milk powder 1 tin dried hydrolysate At back cases with record cards instructions on lid and 1 nasal drip set ready for use

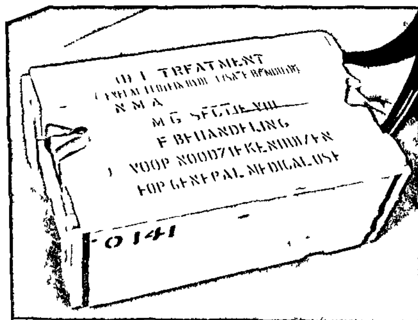



FIG 15 Pack of special emergency foods as dispatched by air

considered nutritional requirements. Their first report made clear recommendations regarding the level of calories and essential nutrients that should be provided by the food in various circumstances. Whilst clearly defining the requirements for good nutrition the Committee had to have regard to the immense supply and transport difficulties that would inevitably arise during an invasion of Western Europe in the prosecution of a hard campaign. They therefore put forward a sub optimal level of food supply based on an estimated *per capita* allowance of 2000 calories a day. This level of nutrition was regarded by the Committee of experts as sufficient to dispel fear of disease and unrest provided it was not maintained for a long period. Without supplementation it would not provide for hard physical work. Formidable supply and transport difficulties immediately before and during the invasion of Europe precluded the implementation of the Nutrition Committee recommendations that a caloric level higher than 2000 per head per day should be adopted as soon as practicable. Accordingly a large proportion of the Civil Affairs food planning was based on the 2000 calorie level.

Although this report is concerned mainly with the medical and nutritional relief of the Western Netherlands reference should be made to the work of those groups responsible for the importation and distribution of foodstuffs. These include the Food and Agriculture and Transport Sections of the S H A E F Mission 21st Army Group the Netherlands District and the Netherlands Military Administration. Other groups that contributed much in the way of special foods, including dried milk and infants food were the Red Cross Organisation and the Queen Wilhelmina Fund.

How well the Food and Agriculture groups attained their goal is illustrated by the following

Requirements estimated [illegible] 1945 [illegible] 171 680 [illegible]
actual deliveries for this peri[illegible]
This is also illustrated by the [illegible]
(see chapter VI) In no less than two weeks the goal of 2000 calories had been reached.

Dutch reports taken from "Slag om B 2" show that 141 636 183 kg of foods were stockpiled in depots of Southern Netherlands for this emergency. Distribution of these supplies was effected through thirteen (13) centers as shown in Appendix No 11.

From the Eastern agricultural provinces considerable quantities of fresh milk and potatoes were transported but exact amounts of these commodities are not known. In addition Relief teams from this area transported 51 000 kg potatoes 8700 kg potato flour 75 000 eggs 35 000 kg flour 110 000 loaves of bread 12 000 kg pulses and 36 000 kg of other foods.

From a report of Major J F TINLEY (Food and Agriculture section of S H A E F Mission) on the food resources in the Western Netherlands are quoted the following data

1 *Grain* (wheat and rye) Produced in this region during 1944 approximately 8 % of the total Netherlands production. Sufficient to last until the end of February 1945 at the ration scale of 1 kg/man/wk. *Some additional was imported from nearby provinces.*

2 *Potatoes* Produced in this region during 1944 approximately 5 % of the total Netherlands production sufficient to last until the end of December 1944 at

the ration scale of 2 kg/man/wk This supplemented with indeterminable quantities of sugar beets and tulip bulbs

3 *Other Vegetables* Adequate amounts in October 1944 decreased markedly during the winter and were exhausted by April 1945 New crops were beginning to arrive in May and June 1945

4. *Beets and Pulses* Produced in this region during 1944 approximately 17 % of the total Netherlands sugar beets production, and 33 % of the total Pulses production Sufficient pulses to last until the end of February 1945 at the ration scale 125 gm/man/wk Some also imported from nearly provinces

5 *Meat* Produced in this region during 1944 approximately 20 % of the total Netherlands production Sufficient to supply 40—50 gm/man/wk from October 1944 to April 1945

6 *Milk* Produced in this region during 1944 approximately 22 % of the total Netherlands production Sufficient during the winter months, to supply about 1 liter/man/wk Small, but indefinite quantities of canned dry milk were available

7 *Fats* (animal and vegatable) Produced in this region during 1944 approximately 20 % of the total Netherlands production Sufficient to supply about 70 gr/man/wk in October 1944 and considerably less through the winter

## E NUTRITION SURVEY PLANS

### 1 *Introduction and Purpose*

With the maturation of plans for the final liberation of the Western Netherlands it seemed eminently necessary to provide for the securing of rapid and reasonably accurate evaluation of the state of nutrition of the population and for the assessment of local food supplies as soon as towns were liberated Such information would be essential to the conduct of the relief program of the Allied Command It was contemplated that the Nutrition Survey teams should enter the occupied areas with the Civil Affairs Detachments and immediately proceed with rapid clinical and dietary surveys, so that information could be furnished to supply officers not later than 24 hours following the liberation of a town

It also was planned, that when the large cities were reached, there should be rapid preliminary surveys to assess the immediate needs of those communities Later much more comprehensive and detailed studies of the populations and the dietaries were projected It was hoped that various laboratory-examinations could be carried out on a small but statistically adequate fraction of the populations groups subjected to physical examination

It was expected that several purposes would be served by the Nutrition Survey teams

1 To determine the immediate needs of the liberated populations for emergency food supplies and medical care
2 To ascertain the requirements for Medical Feeding Teams
3 To advise the Allied Authorities regarding the kinds and quantities of foodstuffs required immediately and over the period of rehabilitation
4 To conduct clinical and laboratory investigations on the effects of long continued underfeeding on large groups of people

5 To advise and support the Dutch Health and Food Authorities

6 To attempt to perfect methods of clinical and dietary surveys toward increasing their usefulness in future population studies

Under the exigencies of field work it proved impractical to attempt laboratory investigations in connection with rapid surveys When detailed surveys were carried out in the great cities of the Western Netherlands much systematic biochemical investigation was done The other projected functions of the Survey teams were performed in a measure which exceeded expectations

## 2 *Methods*

The evaluation of the nutritional status of an individual or of a group of individuals is a difficult task and one that is fraught with many uncertainties When one is dealing with groups of individuals particularly large groups as in a city or section of a country there is the added problem of sampling procedure *Nevertheless it is possible to evaluate in a relative measure nutritional status* and to use this as a rational index for a more intelligent selection and distribution of nutritional therapy or food distribution

In general there are 4 methods available for the evaluation of nutritional status These are as follows

1 Dietary or food histories
2 Clinical examinations
3 Laboratory methods
4 Response to appropriate therapy

In any type of a nutritional evaluation whether it be of a single individual or of a large population area all of these 4 methods are generally used and in these studies of the Netherlands they have all been used But there are variations in these 4 general methods depending upon local circumstances and the available help Thus diet histories may vary from carefully weighed food intakes for each meal to yearly food inventories of a country divided by the total population They may be carried out over only a 1 day period or for several days longer They may be done by trying to find out what people have eaten or by asking them to keep a record of what they do eat in the course of the next few days The exigencies of the local situation generally determine what method of obtaining diet or food histories will be used

Once a diet history is obtained there comes the task of evaluating the foods in terms of specific nutrients For this tables of food composition are used It is known that a great variety of factors affect the nutrient content of foods the genetic background of the seed soil and climatic conditions time of harvesting methods of processing and the ultimate preparation of the food for consumption However when diet histories are carried out over a period of time and on a number of individuals many of these variable factors cancel out and one obtains data that are reasonably reproducible

As will be mentioned later under both the rapid and the main survey reports a number of different approaches to the problem of the diet history were used in these studies The food composition data to calculate the diet histories were taken from weighted averages of the best available data from Dutch English and American

sources The actual figures used are given in the table of Appendix No 12 of this report

After the diet histories have been obtained and calculated in terms of nutrients comes the task of applying them in evaluating the nutrional status of the individual This is generally done in comparison to certain arbitrary nutritional standards In some cases these standards may be what are considered actual requirements but more generally they are so called recommended dietary allowances In either case they are only approximations and are generally not founded on data strictly applicable to man Furthermore they do not consider the extreme variation that is known to occur in the requirements from one individual to another However the diet history when used in conjunction with the other general methods of nutritional evaluation is important

The clinical examination used in nutritional studies is simply a careful physica examination including medical history but with special attention given to variou symptoms and signs that are more or less associated with nutritional deficiencies The clinical examination may likewise vary from complete to superficial depending on the local situation Fortunately for nutritional studies the predominant clinical findings are usually available in parts of the body readily available to examination such as the eyes tongue buccal mucosa and teeth skin of face forearms hands and legs

Results of the individual clinical examination will be found in both the rap and main survey studies of this report Appendix No 13 gives the criteria used for evaluating the various physical findings of the clinical examinations conducted

In general the clinical examinations conducted in these survey studies were brief and consisted of a brief history measurements of height and weight examination of the following eyes upper arms hands face tongue buccal mucosa lower half of thigh and lower legs Tendon reflexes and vibratory sensation were tested when thought necessary Slit lamp or other special examinations were not done except in the large general surveys of Leiden and The Hague

Laboratory studies demand a certain degree of stability of operation for their succesful use They were not done in any of the preliminary one or two day spear head survey (rapid surveys) simply because the pressure to obtain a cursory overall picture of the Netherlands was so great and transportations and communication so chaotic that even the simplest of laboratory procedures was not feasible In the main surveys which were conducted under more tranquil circumstances and with the valuable assistance of considerable Dutch personnel determinations of hemoglobin and total serum protein were done on approximately every third individual These determinations were done by the specific gravity method using a kerosene bromobenzine gradiant tube Laboratory methods to a large extent were used in the general surveys of Leiden and The Hague because these surveys were done at a more leisurely pace by the Oxford team who came equipped to carry out a variety of laboratory work and because of the valuable assistance of a number of Dutch chemists and technicians These additional laboratory procedures and the results obtained are given in the main survey reports of Leiden and Th Hague

The last general method of use in evaluating nutritional status namely respon to therapy as feeding can only be done if one has an opportunity for a seco examination or study This is not always possible in field operations but fortunat

in these Dutch surveys many areas were surveyed on repeated occasions and hence it was possible to have a measure of response to feeding In general it may be said that response of the ambulatory civilian population to feeding was prompt and favourable For example caloric intakes approximating 1000 calories a day were common in many Dutch cities during the second week of May 1945 and clinical signs of malnutrition were high A month later caloric intake had doubled and clinical signs of malnutrition were few The detail of such feedings will be found in a comparison of the rapid surveys of Rotterdam Delft Utrecht and Leiden with the main studies of these regions which were conducted at a later time

### 3 *Plan of operations*

A nutritional survey team depending upon the personnel available is composed of from 4 to 8 or more persons In the studies dealt with in this report the teams usually consisted of the following one physician trained in assessing the clinical signs and symptoms of nutritional deficiency one nutritionist trained in obtaining and interpreting dietary histories one biochemist with the necessary equipment to obtain and analyze blood and urine samples an interpreter and usually one or more drivers

Such a survey team would arrive in the community to be studied early in the morning After a meeting with the Burgomaster or other governing authority the team would separate for a variable period of time from 2 hours to 2 days depending upon the time allotted for the survey while the clinician contacted an outstanding physician in the community and obtained general information of nutritional interest and made arrangements for the selection and examination of the population sample Meanwhile the nutrionist met with the food distribution and rationing officials and obtained general dietary and food supply information and the biochemist arranged the equipment in the selected examination location and made such arrangements as were necessary to permit rapid and efficient processing of the patients through the clinic Usually the remainder of the early period was spent in a study of institutional patients in asylums hospitals and orphanages

Upon completion of these early assignments the team would reassemble at the chosen place and time to conduct the examination of the selected population sample Whenever possible at least three adjacent rooms were chosen so that the patients moved rapidly from height and weight measurements to the physical examination and then on to the laboratory and dietary history phases of the clinic In general it was possible to examine from 100 to 150 persons in an afternoon or approximately 250 persons per day when detailed surveys were conducted Laboratory studies were made on 25 to 50 percent of the total number examined and dietary histories were obtained from approximately 10 percent

Detailed operational procedures both for rapid and main surveys are presented in Appendix No 14 and the specific operational plan for each general survey is included in the respective survey report

## IV THE LAST DAYS BEFORE LIBERATION

### A NEGOTIATIONS WITH THE GERMANS

An unexpected turn of events led to a far reaching change of plans, described on pag 28, for bringing relief from the Allied side of the line

The Reichskommissar, SEYSS INQUART, had become seriously disturbed by the gravity of the food situation Moreover, he had received orders to carry out flooding and devastation on a vast scale in the event of an Allied attack Early in April he sent for Dr HIRSCHFELD, then Secretary General of Economics, and discussed these matters in the hope of finding a way, by which a terrible catastrophe might be averted As an outcome of these talks, an "underground' message reached the Netherlands Government in London indicating that the Reichskommissar would be prepared to open discussion with the Allied Command, if a way to do so could be found

Supreme Allied H Q then instructed Major General Sir FRANCIS DE GUINGAND Chief of Staff, 21st Army Group, to arrange a meeting with accredited German representatives The first meeting was held on April 28th in the village of Achterveld just behind the Allied front lines It was pointed out to the Germans, in unmistakable terms, that the Allies took an extremely serious view of the failure of the German Command, to feed the Netherlands population in their area and that the responsibility carried by the Reichskommissar and his staff was one that could not be evaded The German delegates left to report to their chief, but, before leaving, they were told that another meeting must be held in not more than 48 hours, as the situation would not permit of longer postponement

At the second meeting, presided over by Lt General W BEDELL SMITH, Chief of Staff of Supreme Commander, on April 30th, the Reichskommissar himself attended On the Allied side, Prince BERNHARD of the Netherlands was a distinguished member of the group, that met the disgruntled and unhappy German delegation The Allied plan for sending immediate food relief by air, land and sea (fig 16) was discussed in detail the Germans reluctantly giving way point by point as acceptance of each one was forced on them by unremitting Allied pressure

Among the agreements forced on the despondent Germans, was one permitting passage through their lines under a flag of truce of a non military medical mission to confer with the Dutch Public Health and medical authorities concerning the immediate problem of dealing with cases of acute starvation

The formal agreement with the Germans covering this arrangement is re produced in Appendix No 15

The function of this mission, as shown in the document referred to, was to consult Dr C BANNING, Chief Inspector of Public Health, and then to decide whether feeding teams were urgently needed In that case, having obtained the permission of Oberstabsartz General Dr MEYER, the Senior German Medical Officer in the $B_2$ area they were to communicate the needs to 1st Canadian Corps, by which the requisite relief units would be called forward and sent through the German lines

Immediately this agreement had been reached, four members of the Allied Nutrition Advisory Committee, Sir JACK DRUMMOND, Dr CHARLES LEACH, Dr J F LOUTIT and Dr J BEATTIE were nominated by the 21 Army Group to constitut



FIG 16 German delegates arriving for meeting at Wageningen on April 30th 1945 (see page 44)

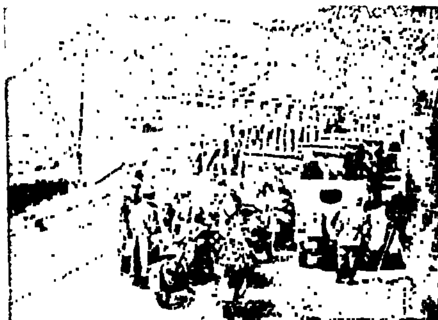


FIG 17 Convoy conveying four members of Medical Advisory Committee waiting at the road block in no man's land to pass into the German lines on the morning of Friday, May 4th

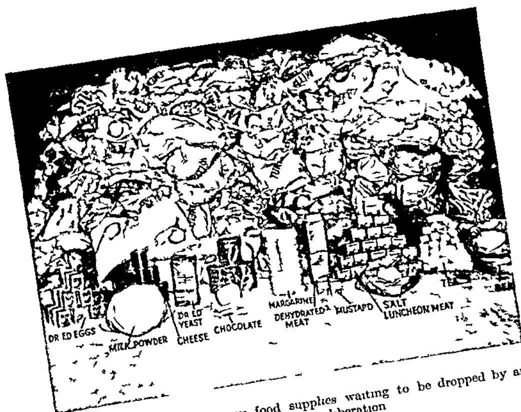



FIG 18 Bags of emergency food supplies waiting to be dropped by air immediately before liberation

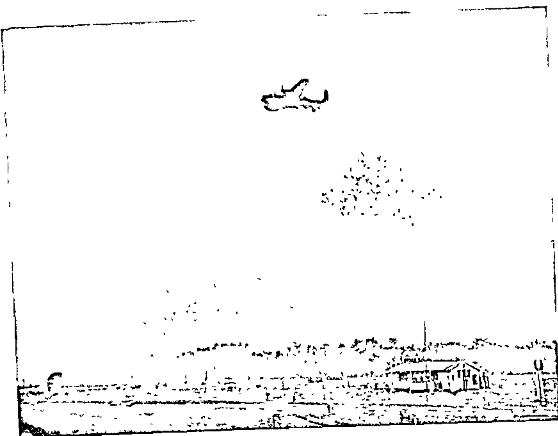


FIG 19 Airdropping of food



FIG 20 Stacks of food piled on the road [illegible] Wageningen and Rhenen awaiting transport into B 2 area immediately after passage into German lines was possible

the special mission and were instructed to prepare to pass through the German line at Phenen on the Wageningen—Utrecht road between the hours of 0900—1100 on Friday, May 4th

Delayed 24 hours by transport difficulties the convoy with the four members of the Red Cross Mission with dispatch riders, passed through the German lines under white flags on the morning of May 5th with German accompanying officers and proceeded to Bilthoven where discussions with Dr BANNING were held

Meanwhile on May 1st dropping of supplies of food by low flying aircraft had begun and also a start had been made with moving across the German lines at Phenen large stocks of food that had been piled by the roadside in that vicinity during the cessation of fighting that marked the period of discussions with the Germans These food stocks were loaded into British lorries by Dutch labour on the Allied side of the line and were then moved down the Utrecht road under German control

The special mission made rapid investigation of conditions in the Hague, Amsterdam and Rotterdam consulting the leading health authorities in each city and reached the decision to ask immediately for permission to bring in eleven feeding teams Returning to Hilversum to communicate their request to General Dr MEYER they found this German Officer and senior members of his staff in no fit state for further discussions Capitulation was imminent The following day, survey teams A and B moved forward to establish temporary H Q at Bilthoven They at once went into action in making rapid nutritional surveys Dr BURGER also arrived at Bilthoven and learning what the situation was called forward eleven feeding teams from Eickom The test ward unit and laboratory were soon established at the Zuidwal Hospital Hague

B NUTRITION SURVEYS OUTSIDE WESTERN NETHERLANDS

During late March and early in April the Survey teams made rapid and superficial surveys in the provinces of Groningen Overijssel and Eastern Gelderland, under the direction of Dr SYDENSTRICKER to test out operational procedures in the field During this phase methods were standardized and observations were calibrated There were no real food problems in these areas at that time From April 15 when Arnhem was liberated until April 30 rapid surveys were made in fourteen communities (Appendix No 16)

Detailed accounts of clinical and laboratory investigations in two groups of severely malnourished patients a group of Todt workers and inmates of an insane asylum are given in the same appendix Poultry produce and vegetables were available in abundance and the inhabitants were healthy in appearance Certain special problems did exist in view of the fact that there had been many Todt camps in the region wherein Dutch civilians were forced to work on German fortifications The conditions in the camp at Rees were said to be particularly bad The men, who had survived their experience in the camp had been removed about a month before and had been distributed in hospitals throughout this area All of the men remaining in the various hospitals were examined They were in surprisingly bad condition when one considers that they had been captured in November and December and were in the Todt camps for only a period of three to four months

Questioning and examination revealed that it was maltreatment, poor living conditions and disease rather than uncomplicated lack of food, that were responsible for their condition They had been billeted during the exceptionnally severe winter in sheds with roofs but no walls and most of them suffered frost bite There had been no sanitary facilities and diarrhea had become an almost universal complaint They had been supplied with a ration containing 1500—1800 calories, but the Germans had refused to provide any food to those who could not work so that those, who became incapacitated from any cause, deteriorated rapidly Even after four weeks in hospital, these men showed evidence of severe cachexia, brought about for the most part by the diarrhea which they experienced Cultures of the stools had not been possible for some months, due to lack of laboratory facilities but in the early states of the epidemic a few cultures had been positive of Shiga dysentery Difficulty was being experienced in the hospitals, who were treating these men because of the lack of variety of food and supplies to treat their diarrhea Additional foods and medications were, however, made available as soon as possible Average weight of 106 of these men ranging in age from 16—46 years and mostly in the 20—36 years range was 54,5 kg

In the province of Gelderland rapid one day surveys were made in Arnhem Velp, Ede, Zutphen, Barneveld, Harderwijk, Apeldoorn, Lunteren, Nijkerk, Nunspeet and Epe (see Appendix No 16) These surveys were performed immediately after the towns had been liberated, whenever possible on the same day The surveys consisted of a physical examination and dietary questioning through a Netherlands medical student, of approximately 150 persons from the street In addition, interviews with the ration controller provided information on food intake, and examination of the occupants of all institutions in the area revealed many special problems Generally, the difficulties in this area were due to severe overcrowding The entire population of the cities Arnhem, Oosterbeek, Rhenen, Wageningen and Bennekom had been forced to evacuate in September 1944 following the Allied air borne invasion, and most of the people had moved into small towns nearby In addition there had been a considerable number of evacuees from the Western Netherlands, when the food supplies had begun to fail in that region As a result many of these cities and towns contained over twice their normal population Food supplies would have been adequate to meet the requirements of the usual number of people but were not sufficient to maintain the greatly increased population Food intake varied widely The legal ration of 500 to 1000 calories represented one third to one half of the total food intake The remainder depended on the ability of the individual to obtain food from extra legal sources Since this required travel to the farms, the young and middle aged, to whom such activities were possible, fared much better than the elderly people Also there was a variation in the food available in various districts In the region near the IJsselmeer, the population enjoyed the produce of an excellent agricultural area and a fishing industry, and were much better off than people in the southern part of the Province In no area in Gelderland had the factors of overcrowding and resulting food scarcity prevailed for longer than six months *and very few physical signs resulted* The majority of the people were thin but famine oedema was seen very rarely and only in elderly people Children were somewhat retarded in their development but specific evidences of vitamin or other nutritional deficiency were not encountered in the general population Certain specific problems were found among the occupants of institutions

In asylums and homes for the aged, only the legal ration was available Deaths from starvation had been reported and occasional cases of famine oedema were found

*The situation in Gelderland has been such that the inhabitants have been uncomfortably hungry because of lack of food but, with the exception of occasional cases existing under special circumstances little or no permanent damage has been done the population as a result of the food shortage*

# V ENTRY INTO THE WESTERN NETHERLANDS

## A FIRST IMPRESSIONS ON LIBERATION

The first Allied personnel to enter towns of the Western area were the four members of the special mission with their drivers and dispatch riders on the morning of May 5th Although accompanied by German officers, the convoy received a tumultuous welcome from the crowds in the streets It was apparent that the people knew, that the Germans were about to capitulate in Western Netherlands Long hidden Dutch and Allied flags were appearing everywhere The German troops looked sullen and discomforted

The ecstatic people in the streets looked thin, but flushed with emotion and enthusiasm their faces did not look as drawn and lined as had been expected or as was later revealed, when the intense excitement had somewhat abated

Any superficial impressions that might have been created by the appearance of the crowds in the streets was quickly dispelled when members of the special mission spoke with the medical and public health officials in The Hague, Amsterdam and Rotterdam From them they heard grim accounts of thousands of people in hospitals or hidden away in their homes in the last stages of starvation of hunger oedema on all sides and of a high mortality among infants very young children and elderly people especially men

It is very important to record how easily a completely misleading impression of the nutritional condition of a population can be formed on first contact with the people in the streets Many examples could be given from the experience of nutrition experts who entered liberated areas of Western Europe soon after they were freed from the enemy but none is as striking as the case of the towns of Western Netherlands

The arrival of the survey teams and of the first echelon of the medical feeding teams soon provided ample confirmation of reports of the grave state of thousands upon thousands of the towns people The emergency hospitals were filled with emaciated patients many moribund or in a very critical condition Nearly a quarter of the people examined in the worst parts of Rotterdam and Utrecht showed signs of hunger oedema The doctors and nutrition experts had no doubts whatever that very serious effects of starvation were visible on all sides in spite of the fact that many of the people in the streets looked in a better condition than had been feared would be the case Nevertheless, when the Allied Forces moved into the Western towns two days after capitulation there were many who formed a false impression of the situation because they saw only what was to be seen on the streets Very misleading reports gained a wide circulation in the World s press For example the London Times of May 23rd 1945 printed an article that contained the following statement from an authoritative source

We had expected to find the most terrible conditions there, but we did not need the special teams which stood by ready for action There were some cases of advanced malnutrition but no cases of actual starvation

Such a report at such a time could grievously hamper relief efforts, particularly those concerned with the provision of the necessary food supplied To counteract its effect a number of senior officers of S H A E F and 21st Army Group were shown the rows of pitiful patients some of the many hundreds then under treatment

for severe starvation and hunger oedema in the wards of the hospitals Before long press reports had brought the picture into fairer perspective and the world knew the truth of the starvation and sufferings of the people of the Western Netherlands towns

B RAPID NUTRITION SURVEYS IN THE WESTERN NETHERLANDS

During the first five days of May activities of survey teams A and B were stopped because of the anticipated capitulation of the German Army and the move into the Western Netherlands

On May 7th after the German capitulation the survey groups proceeded into the Western Netherlands with the first Allied troops

Setting up headquarters in Bilthoven just outside of Utrecht the groups continued their rapid surveys in the Western Area Such surveys were performed in Utrecht, Rotterdam, Hilversum Haarlem Alkmaar s Gravenzande, Maassluis Vlaardingen Dordrecht Amersfoort and Delft (Appendix No 17) In these preliminary surveys in large cities there was no attempt made to evaluate representative groups of the population Instead a poor area of the city was chosen on the advice of the Burgomaster and Director of Public Health and people on the streets in this area were examined and questioned concerning food intake In addition certain of the institutions particularly those treating famine cases were visited and an attempt was made in each city surveyed to visit a number of homes in the poor districts to obtain some impressions of the number of individuals who were ill at home

The technique employed was simple and more or less similar to that used in the preliminary surveys outside the B. area The Inspector of Health in a city was interviewed and requested to designate the area or areas in which examinations are to be conducted He was also requested to furnish nurses, interpreters and clerks to assist in examining patients and recording observations The dietist of the team interviewed the local Food Administrator and secured the legal ration alottments during the current rationing period After necessary arrangements had been completed, the examining room was set up in a health centre, school or office in the selected area and *nurses brought in people from the neighbourhood usually from the passing crowds* Age sex weight and height were recorded and rapid inspection made for the common signs of underfeeding and malnutrition A dietary history, qualitative and quantitative covering the last 24 hours was secured from every 5th person examined It was possible to examine 150—200 persons a day and to secure a dietary history on 30 to 40 After completing the ' clinic ', visits to the city's hospitals were made to ascertain the number of patients under treatment for severe starvation

*Conditions in these poor areas of the cities of the Western Netherlands were very different from those prevailing in Gelderland No fat people were seen and most of the subjects were described as thin very thin and occasionally emaciated Famine oedema was common In the city of Rotterdam among 156 people examined in a poor area on May 9, 27 % showed bilateral dependent oedema with no obvious cause other than lack of food The evidences of specific vitamin deficiency however occured rarely and no single case of acute rickets, scurvy or pellagra was noted The population was none the less in dire straits and required more food quickly In addition there were thousands of people who required the special facilities of the Medical Feeding Teams Results of the investigations of these rapid surveys are summarised in Chapter VI, b*

## C MEDICAL FEEDING TEAMS AT WORK

### 1 *Mobilisation and stationing of the Medical Feeding Teams*

Shortly after the teams were equipped and trained in the Training Centre of the Netherlands Red Cross Help Corps (N R X H ) at Breda (Commander Lt Col LAMAN TRIP) the first 10 teams were mobilised and stationed there on April 19 1945 On the following day the first began work at Velp, a little village in the neighbourhood of Arnhem

The reason for this action was chiefly to discover how the plans made fo the operation of a Feeding Team worked in practice and whether there were any deficiencies in the equipment From a nutritional point of view the situation in Velp was fair, though not entirely satisfactory, there were cases of hunger oedema among the old people (see Appendix No 16)

It appeared that some improvements in the organisation of the teams could be completed in a short time (e g cooking facilities for the teams etc ) Special difficulties were also experienced in embodying suddenly into a military organisation a team consisting of civilians with only one week's training

On May the 2nd, 25 teams were mobilised, 10 of which were at Breda and 15 at Ellecom

In a conference on May 2nd at Ellecom Lt Col KENNEDY, A D M S of Netherlands District announced the agreement entered into by the Allied and German Military Authorities, concerning the entry into German Occupied Holland of the Red Cross Mission (see Appendix No 15) In consequence of this agreement four members of the Allied Advisory Committee entered the occupied territory on Saturday May the 5th to make a preliminary assessment of the situation and to prepare the calling forward of the Feeding Teams

As already described (p 44) the capitulation on May 7th changed the situation completely On that day the staff of the Medical Feeding Teams could set out for the B 2 area and the original plan of operation could be resumed (Bilthoven 7 5 '45)

After the preliminary reconnaissance by the Advisory Committee, 4 teams were immediately called forward to Amsterdam, 6 teams to Rotterdam and th Test Ward Laboratory and 1 team to the Hague

In the days following, reports about the preliminary surveys made it possib to direct a number of teams to towns that were most in need of help

Yet a number of unexpected difficulties was experienced at this stage These resulted from the following causes

*a* frequently the gravity of the situation was curiously underestimated by local authorities

*b* it was not realised quickly enough that the aid rendered, offered great possibilities

It was this psychological attitude that created the greatest difficulties The misery gone through the underfeeding, the psychical depression made many people little susceptible to new ideas There arose a decided narrowing of outlook, th inclination to react with the attitude of "leave me alone, I'll manage myself" Moreover owing to the misery gone through the gravity of the situation was not sufficiently realised hunger oedema was so frequent that many did not regard it as a serious matter

On the other hand among the helpers still imbued with a 'liberation neurosis' there was a blazing enthusiasm a desire for deeds and action In spite of the prevailing distress it took some time before there was a rapprochement between these two mental states

Whereas in some places an enormous amount of work was quickly done with great energy by visibly exhausted authorities and physicians there were other localities where even the accommodation of the teams caused difficulties In such cases the teams had to be 'disposed of as vacuum cleaners are disposed of in an almost satisfied market and that in spite of an urgent need of assistance, deaths from starvation and of many suffering from hunger oedema

The experience gained in this relief work brings into prominence the vital importance of recognising the effect of psychological reactions, both on the part of the sufferers and of those who bring aid Much precious time will be saved, if there are clear instructions regarding the relationship between the two

The location of the teams took place according to the scheme in Appendix No 18

It soon appeared that the situation clinical and epidemiological, was quite different from what had been expected as will be explained further in paragraph 2 Sufficient to say, that in addition to giving hospital treatment, we had above all to institute out patient aid by which aggravation of the situation could be prevented

Here it was of importance to co ordinate the existing organisations to the greatest possible extent In this connection the excellent work of the I K B and I K O, the Inter Church Organistion should be mentioned

Happily the general physical condition of the doctors was fastly different from what had been expected It had been thougt that they would be physically and mentally exhausted and so unable to play an important part in the rehabilitation of their patients In fact it was found that though the doctors had suffered, they were able to and did play an enormous part in the relief work Valuable scientific data had been collected by them before the liberation and they were able to continue this excellent work after relief came and so advise the incoming Feeding Teams

The available foodstuffs were distributed according to the scheme given below

| | | | |
|---|---|---|---|
| Amsterdam | 20 % | Haarlem | 8 % |
| The Hague | 15 % | Schiedam | 6 % |
| Rotterdam | 20 % | Leiden | 6 % |
| Utrecht | 10 % | Dordrecht | 5 % |
| Delft | 5 % | Hilversum | 5 % |

In the larger cities where several teams were at work, it appeared to be necessary for co ordination to designate a local director With great readiness local clinicians offered to undertake this task aided by a leader of the Feeding Teams The Directors of the local Public Health services also cooperated in a most helpful manner

## 2 *The work of the teams*

As soon as the teams had settled down in the towns to which they were directed, they started work The clinical and epidemiological picture of starvation in the B 2 area appeared however quite different from what had been foreseen Therefore

plans had to be changed immediately and the work had to be divided in two parts

*a* out patientstreatment

*b* in patientstreatment

The former treatment served both a preventive and a curative purpose Patients examined in poly clinics (out patient departments) were admitted to hospital, when necessary In addition "field work for tracing patients proved to be of very great importance In back streets, byeways and slums seriously ill patient were traced and removed to hospital Motorcars provided with loudspeakers broadcast information By means of publications in the local press and by co operation with local physicians as many starvation cases as possible were traced

Especially among the in patients but also in the case of the out patients the majority belonged to the higher age groups, while more men than women were in need of help This fact was the cause of a reproach, that the Feeding Teams took good care of old people, but not of the rising generation This criticism was not justified Aid to children presented a very special problem, as many undernourished and neglected children were found In general however, there was no question of widespread starvation among this group They presented a task for the social workers rather than for the Medical Teams This was afterwards confirmed by the results of extensive surveys The survey teams reported that "infants seem to have fared best

Dr SOETERS, pediatrist of the Test Ward made a report about the state the children, from this report we quote the following

' The data are based on an inquiry among a large number of pediatricians in the B 2 area Infant mortality (infants and babies) had been especially high in the coldweather of the spring of 1945, more owing to want of care warmth clothing and bedding than to want of food Many older children belonging to the lower social classes were wandering about begging, stealing and plundering On the whole the hospitals were still in a position to supply the sick infants with appropriate food

This short quotation may suffice to show, that the plans made for the special feeding of starved children proved superfluous so that the foodstuffs (flour, glucose and milkpowder) reserved for this purpose, became available as extra feeding for adults

Appendix Nr 19 gives a summary of the work of the various teams

In all about 279 000 patients were treated by the teams or the co operatin agencies (Municipal and I K B polyclinics) Of these, 3000 patients were treate in hospitals of these 275 or 9 %, died The greatest mortality occurred in t first week In aggregrate 192 000 patients received extra food through the int mediary of the relief organisations The number of cases fed with hydrolys amounted to 1200 or 40 % of the total number of cases treated in hospital work was not equally divided over the entire period In the busiest week (May 27t June 3rd) the situation was as follows in table 8

TABLE 8

| | NUMBER OF BEDS OCCUPIED |
|---|---|
| Amsterdam | 280 |
| Haarlem | 50 |
| Leiden | 60 |

| | |
|---|---|
| The Hague | 220 |
| Delft | 120 |
| Dordrecht (just started) | 5 |
| Schiedam | 80 |
| Vlaardingen | 50 |
| Utrecht | 45 |
| Zeist | 10 |
| Hilversum | 70 |
| Bussum | 30 |
| | |
| New cases admitted in hospital | 400 |
| Domiciliary visits | 3000 |
| Polyclinic examinations | 7000 |

The figures in this table are certainly lower than they actually should be, in particular the number of the domiciliary visits was not exactly recorded.

More detailed records are available about patients treated in hospitals. These data are assembled in table 9. From these figures one can derive the number of

TABLE 9. DETAILS ABOUT 750 IN-DOOR PATIENTS TREATED IN HOSPITALS IN MAY—JUNE 1945

| Age group | | Number | Time of treatment (average) | Died % | | Hydrolysate treatment % | | Cases with oedema % | |
|---|---|---|---|---|---|---|---|---|---|
| 81 and < | Male | 19 | 316 (16.6) | 11 | (57.9) | 6 | (31.6) | 10 | (52.6) |
| | Female | 20 | 437 (21.8) | 6 | (30) | 14 | (70) | 15 | (75) |
| 71—80 | Male | 76 | 1562 (20.6) | 12 | (15.8) | 46 | (60.3) | 53 | (69.7) |
| | Female | 93 | 1913 (20.6) | 20 | (21.5) | 55 | (59.1) | 57 | (61.3) |
| 61—70 | Male | 116 | 2716 (23.4) | 21 | (18.1) | 67 | (57.8) | 80 | (68.9) |
| | Female | 91 | 1740 (19.1) | 13 | (15.4) | 58 | (63.7) | 40 | (43.9) |
| 51—60 | Male | 88 | 1953 (22.2) | 14 | (15.9) | 55 | (62.5) | 40 | (45.5) |
| | Female | 42 | 790 (18.8) | 4 | (9.5) | 24 | (57.1) | 17 | (40.5) |
| 41—50 | Male | 47 | 9[illegible]0 (19.5) | 8 | (17.0) | 20 | (42.5) | 21 | (44.7) |
| | Female | 29 | 456 (15.4) | 3 | (10.4) | 19 | (65.5) | 13 | (44.8) |
| 31—40 | Male | 11 | 229 (20.8) | 1 | (9.1) | 7 | (63.6) | 4 | (36.6) |
| | Female | 24 | 435 (18.1) | 4 | (16.7) | 15 | (62.5) | 9 | (37.5) |
| 21—30 | Male | 12 | 235 (19.8) | 1 | (8.3) | 6 | (50.0) | 2 | (16.7) |
| | Female | 8 | 168 (21.0) | — | (—) | 4 | (50.0) | 4 | (50.0) |
| 11—20 | Male | 12 | 233 (19.4) | 1 | (8.3) | 1 | (8.3) | 5 | (41.7) |
| | Female | 18 | 344 (19.1) | — | (—) | 9 | (50.0) | 3 | (16.7) |
| 1—10 | Male | 16 | 286 (17.9) | 1 | (6.3) | 5 | (31.3) | 1 | (6.3) |
| | Female | 18 | 406 (22.6) | 1 | (5.6) | 7 | (38.9) | 1 | (5.6) |
| 0—1 | Male | 5 | 61 (12.2) | 2 | (40.0) | — | (—) | — | (—) |
| | Female | 5 | 41 (8.2) | — | (—) | — | (—) | — | (—) |
| Total | | 750 | 15243 (20.3) | 123 | (16.4) | 418 | (55.9) | 375 | (50.0) |

in patients of different age groups that were treated by the teams the incidence of hunger oedema and the rate of deaths in these groups

### 3 *Out Patient Treatment*

The distribution of food relief required time to bring into operation During that time there was actually a reduction in the amount of foodstuffs distributed (see fig 7) This drop which for infants and young children was less pronounced proportionally involved risks for all patients in a serious state Moreover in the first week the food available was liable to cause intestinal upset in underfed persons Thus it was considered of greatest importance to select and treat the most underfed by giving them light digestible and nourishing food rich in protein for at least 6 weeks

On consultation with the Director General of Food supply (Dr LOUWES) it was decided by the latter that the Feeding Teams were to be the only agents for the *selection* of the out patients while the I K B would regulate the *supply* in so far as the teams could not do this from their own food stocks

A number of polyclinics or out patients centres were founded scattered over the towns to which patients could be referred by their family doctors Direct consultation of the patients in the polyclinics was as a rule prohibited to avoid over crowding and congestion

Patients who were in too serious a state to visit the polyclinic were noted down to be visited at home The social workers worked to the best of their ability and searched everywhere for cases needing treatment Often it was absolutely impossible for them as laymen to judge the situation The teams however made the best of it in spite of the scarcely suitable organisation of the teams for polyclinical work and field work (See for scheme of work chapter III b and Appendix Nr 9)

Patients were divided into 3 categories

*a* for admission into hospital

*b* for polyclinical feeding

*c* requiring no special measures

Indications for admission into hospital were not restricted to cases needing tube feeding as these were rare all serious cases of hunger oedema or cachexia had to be treated in hospital

All those 25 % underweight or more or considered to be in poor general condition in so far not belonging to group *a* were given extra food as outdoor patients

Wherever possible the organisation of the polyclinics was on the basis laid down by other organisations (Municipality—I K B ) The chief factor in the selection as well as in the treatment of patients by the teams was *speed* To this principle all other considerations were sacrificed It was therefore difficult to collect detailed data suitable for scientific work

The teams themselves directly undertook the distribution of extra food to all patients from group *b* mostly a parcel of food was given for one week to start with containing 1500 calories per person per day (milkpowder flour glucose and other foodstuffs (table 10)

TABLE 10 QUANTITIES OF FOOD DISTRIBUTED BY THE TEAMS IN THE FIRST FEW WEEKS (BEFORE SUPPLY THROUGH I.K.B. SPECIAL ORGANISATION WAS UNDERTAKEN)

| | |
|---|---|
| Bags of sugar | 2[illegible]4 |
| Bags of flour | 180 |
| Bags of oats | 141 |
| Cases of meat | 343 |
| Boxes of egg powder | 68 |
| Packages of biscuits | 1[illegible] |
| Boxes of biscuits | 27[illegible] |
| Tins of biscuits | 827 |
| Casks of milkpowder | 175 |
| Cases of tinned milk | 76[illegible] |
| Cases of soap | [illegible]3 |
| Boxes of glucose | 166 |
| Tins of chocolate | 271 |
| Bags of rice | 43 |
| Bags of riceflour | 34 |
| Bags of salt | 24 |
| Bags of groat | 97 |

In addition to this unknown quantities of food were distributed, which the teams had secured by their own means through collections in the South from private persons and from the Netherlands Red Cross

Later on it was decided in consultation with the food supply authorities and the I K B, to distribute to all polyclinic ambulant patients during 6 weeks, one litre of porridge to be eaten at the distribution points containing 1000 calories per litre and in addition to this [illegible]00 calories per day (milk sugar biscuits, eggs) to take home Home patients received an equivalent of these quantities at home (For details see Appendix Nr 20)

The necessity of this food was among other things inferred from the experiences with the clinical patients who only began to feel fit when they got food rich in calories and protein It was obvious that supplying this group with nourishing food might considerably contribute towards raising the resistance against infectious diseases (tuberculosis dysentery diphtheria)

Examples of the work of polyclinics are found in Appendix Nr 21

The teams worked night and day not only on medical work but on anything that could contribute towards alleviating need In several places assistance was rendered in unloading ships in transporting foodstuffs and such labours

### 4 *In Patient Treatment*

Hospital accommodation for serious cases was generally speaking adequate [illegible]

accommodation could be and was utilised as emergency hospital accommodation for those seriously ill from starvation, who could not be taken into the proper hospitals

In all other respects the outlook was bad Fuel gas, electric current and even in some cases water supply were lacking and there was a serious shortage of nursing staff Moreover, both doctors and nurses inevitably were debilitated by the effects of the period of food shortage Much had to be improvised at very short notice

For example, an emergency kitchen, with field stoves, was erected on the balcony of a ward at the Leiden University hospital and put into operation in less than 24 hours There was a call that had a good response for local volunteers and others from the South, to reinforce the nursing staff The duration of the treatment of indoor patients appeared to be much longer than was expected In addition to the medical indications the social indication also played a very important part in the decision to admit The need made admission into hospital very attractive for these patients, this frequently caused difficulties in discharging patients Nevertheless the hospital accommodation of one kind or another, proved to be sufficient to deal with the flew of gravely ill people

### 5 *Demobilisation*

Towards the middle of June it became obvious that the medical authorities in the Western area were fully in control of the situation and that, therefore, the time to demobilise the Medical Feeding Teams had come Demobilisation began to operate on June 18th and was completed by July 1st

The 51 teams had originally had a full complement of 800 persons, but by local recruitment in the field at times of high pressure the number attained a maximum of about 1000

Throughout a trying and difficult time they worked unflinchingly and with great enthusiasm and devotion What they achieved in those hard times is a fine tribute to the spirit that led them to volunteer for the task of bringing relief and happiness to their fellow countrymen whose lot had been so much harder than their own

Fortunately, no serious case of illness and no death occurred among the team personnel throughout the time they were mobilised

### 6 *Discussions and Criticism*

In discussing how the operations of the emergency feeding teams could have operated more efficiently, it is well to point out two false assumptions which seriously affected the early work

1 that patients in severe starvation states cannot swallow and digest simple foods and

2 that fragmentary intelligence, mostly from non medical sources, is of real value in assessing a medical situation

Fortunately the organization was sufficiently flexible to make rapid adjustments Below are a few suggestions which may guide those, whom are called upon in the future to meet similar emergency feeding

1 When non military personnel are suddenly placed in a semi military status great care must be exercised in defining authorities, channels of communication obligations and the rights of the individuals making up the group

2 The main efforts of such emergency teams should be directed to polyclinic activities leaving the major burden of clinical work to physicians within the area in so far they are physically fit to bear the burden

In giving aid three groups will therefore need be taken into account

*a* the normal underfed population

*b* those with 25 % body weight loss ambulant and near starvation,

*c* actual starvation i e cachexia pronounced oedema and those with complications

3 In order to satisfy the conditions above medical feeding teams should consist of

*a* medical selection group

*aa* polyclinic groups

*ab* field workers

*b* medical distribution teams

*c* clinical teams

Naturally the composition of these teams will have to be quite different The personnel of these teams should consist of

*aa* physician nurse assistant nurses and some clerical staff,

*ab* physician medical students male and female nurses Red Cross Staff and social workers

*b* dieteticians distribution officials cookery teachers kitchen servants,

*c* physicians several certified nurses assistant nurses and administrator

Broadly outlined the task of these teams should be arranged as follows

*Groups aa and ab* Selection and distribution of the patients for groups *b* and *c*

*Group b* Distribution of light digestible food both in a prepared (central porridge kitchen) and a packed state

*Group c* Clinical treatment of serious patients discharged patients are transferred to group *aa* and *b* for their after care

4 In the selection of the foodstuffs for relief, the following considerations should be taken into account

*a* the great frequency of stomach and intestinal disorders (achylia gastrica *diarrhoea) makes it necessary to supply especially light digestible food*,

*b* when hunger oedema is prevalent it is of importance that the quantity of water supplied is not too great and that the diet supplied contains little salt

*c* the food supplied must be rich in protein

5 The psychological side of relief deserves great attention Cooperation and advice of experienced psychologists and psychiatrists is advisable Effective early education and information on the object organisation and possibilities of relief may lead to many lives being saved

It was a great privilege for the physicians and their assistants from the Southern provinces to be allowed to render assistance in one of the greatest relief missions ever carried out With great admiration they recall the untiring work of so many physicians and co operators in the hunger stricken areas, who themselves

were in a critical physical state, but, who, nevertheless threw themselves into the relief effort in a manner that is beyond praise

D WORK OF THE TEST WARD

As mentioned on page 31 the preliminary planning arrangements included the for alled the Test Ward, which was to operate in ard was to provide for a 40/50 bed unit 4 *physicians (including 1 paediatrician)*, 3 head nurses, 17 nurses, 5 social workers, 1 dietitician 1 administrator, 1 cook and 2 assistants These were all to be Netherland personnel

The Research Laboratory Staff consisted of 3 scientific workers and 6 technicians and was composed of both British and Netherland personnel The latter were recruited mainly from the Research Laboratories of N V Organon at Oss This section was formed at Oss early in April 1945 with the valuable assistance of Dr TAUSK Director of the Research Department and Dr LENS, *Chief of the Research Laboratory*, who with Dr J BEATTIE supervised the training of the technical staff This was completed by the end of April

The original plan (see p 32) envisaged a period during which several of the smaller cities, for example Utrecht, would be liberated before the large cities of Western Holland It was originally intended that during this first period the Test Ward and Research Laboratory would assess the value of various methods of treatment *The most suitable* method could then be adopted as a routine *by the other* feeding teams, when they were called up for operation The research units would then be free to proceed with the study of the starvation state and the early phases of recovery

In fact, the surrender of the German forces on May the 7th opened up the whole of Western Holland at once Thus all plans for systematic preliminary studies were ruled out The Test Ward and Laboratory Section moved immediately into the Hague and were given wards and laboratories in the Gemeente Ziekenhuis (Municipal Hospital) The unit was faced with the immediate problem of dealing with large numbers of starving people in urgent need of medical care Critical control of treatments at this stage was handicapped by the fact, the team as a whole had never worked together in clinical practice, and not all the staff had had experience *in the minutiae of routine of a metabolism* ward Moreover the Laboratory Section although it had brought in supplies of compressed coal gas and butane was prevented from operating for some days by the absence of electricity and water supplies

The investigational programme was re cast in view of the new situation The main task of the unit was to determine if hydrolysed protein possessed any advantage over whole protein *in the treatment of severe emaciation* The second task of accumulating physiological and biochemical data on the starvation state was complicated in the beginning by the inadequacy in numbers and experience of the nursing staff The Test Ward although much more liberally supplied with nurses than the ordinary feeding teams proved to be understaffed to cope both with the ordinary nursing problems of 50 acutely ill patients and with the supervision of the intake of food and the collection of excreta The staff responded magnificently in the general management of patients, but it was seriously overworked in the early phases of the relief period

The work fell naturally into two periods The first phase covered the period when the patients admitted had not yet had access to increased rations The second phase commenced after about a month when it was necessary to obtain more complete data on several points The patients then studied had had access to increased rations but judged by ordinary standards were still suffering from severe undernutrition

Patients seen during the first phase were eminently suitable for short term nitrogen balance experiments designed to evaluate the two forms of protein Clinical studies combined with plasma protein estimations were carried out haemoglobin and haematocrit determinations by the Phillips and van Slyke method were made where possible plasma volume was estimated oxygen consumption measurements were made when a spirometer became available nitrogen balances were calculated on as many cases as possible but some figures had to be rejected either because the subject had eluded supervision and had had access to more than the permitted food intake or because of doubt about the collection of excreta particularly in cases who developed diarrhoea

In the second phase more critical work was permitted The urgency of the situation had disappeared The majority of the patients were no longer dangerously ill The staff had learnt how to supervise the intake and output of the starved patient who by ordinary standards was amoral and not above filching an unfinished portion from a fellow patient In general in this phase the nitrogen balance periods were longer and the work was directed towards establishing levels of intake effective for retention between calories and nitrogen input which gave maximum retention and the most economic combination of these calorie and nitrogen inputs

The first phase lasted from the establishment of the Test Ward and Laboratory Section at the Hague until the end of May The second phase lasted for 6 weeks but new clinical cases were admitted after the last few days of June and even these cases admitted in June were those already improving

Among the lessons learnt from the experience of the Test Ward and its Laboratory Section are that such units should be well trained in advance in the practical handling of cases of metabolic disturbance that there should be the closest liaison in training and in action between the clinical and laboratory sections that it should be generously staffed (for a 50 bed unit double the nursing and dietetic staff of the present unit would have been desirable) and that if the unit as a whole is to function efficiently its individual sections should not be called upon to handle more material than its training and experience justify

### E MAIN NUTRITION SURVEYS

The initial spearhead surveys totalling eleven were completed on about May 16th and at that time the Medical Feeding teams were at work in each area where they were urgently needed At this point it was clear that the population of the Western Netherlands was rapidly improving as a result of the increased food intake and that the picture of starvation apparent at the termination of the German occupation would quickly disappear

The Public Committee the Netherlands Military Authorities and S H A E F Mission to the Netherlands accordingly requested that survey teams undertake more detailed surveys in representative areas in the cities of the Western Netherlands

in an attempt to obtain as true an evaluation of the situation as was possible in the short periode before the picture changed completely It was arranged that the two survey teams, who were joined by a third team from Oxford University, would be supplemented by Netherlands physicians, dietists, secretaries and other help Each augmented team was then to undertake a more thorough clinical, food intake and laboratory survey in the Western Netherlands

It was considered essential that these surveys should be conducted as speedily as possible, because conditions were rapidly improving It was impossible in the time available to attempt an evaluation of a statistically valid number of the inhabitants of the cities Instead the Department of Health was requested to choose a number of areas in the city of poor, intermediate and upper social class that would be representative of the city generally Each of these areas contained approximately 2000 persons and a valid sample of each area was examined Six to fourteen such areas were chosen in each city, in a ratio which was considered by the Department of Health to be representative of the city A group of 25 to 50 social workers, interpreters and volunteer workers were recruited locally to aid in the survey Two or more of the workers were assigned to each area to be studied and they were required to enter statistically, representative homes within the district and interview the family

Information was obtained in each home concerning the total number of occupants and their state of health Any deaths which had occurred in the home since January 1st, 1945, were investigated, any patients ill in hospitals were visited by physicians from the survey team and the remainder of the family was requested to appear for examination at a specific time at the public health centre in the area Sufficient families were interviewed in each area to provide a total number of approximately 250 persons to be examined

In order to insure that all members of the family would actually come to the examination the subjects were told that each individual examined would receive his choice of a few cigarettes or a chocolate bar while at the Health Centre A group of ten to fifteen social and voluntary workers helped in the actual examination each day, performing such tasks as t[illegible]ng of names, addr[illegible] [illegible] measuring

[illegible]

first 50 subjects for the morning examination were asked to appear at 0915 hours and 50 additional subjects came to the clinic each half hour thereafter until the group was completely examined On appearing at the clinics each individual presented a card on which was inscribed his name and address This was transposed to a numbered history-form and information concerning the age, sex, usual trade, and present work were obtained In addition, all individuals over 24 years of age were asked to estimate their 1939 weight Each subject was then weighed and measured These procedures were both performed with outer clothing and shoes removed One half or more of the subjects visiting the clinic were interviewed by a Netherlands senior medical student concerning their physical complaints After listing spontaneously mentioned complaints, specific inquiry was made into the incidence of diarrhoea, fatigue, weakness, muscle pain and paresthesias, and in the case of women, amenorrhea The individual to be examined then proceeded to the rooms for physical examination, where two physicians performed a rapid but relatively complete nutritional examination No attempt was possible in the time available to do a

thorough physical examination and only those findings which might be due to nutritional deficiency were sought. Each finding was recorded in three degrees of severity. If it were present to a mild degree the figure 1 was entered in the column opposite, if moderate the figure 2 and if severe 3. Because all the physical examinations were not performed by one physician it was obviously impossible to attain complete uniformity in evaluating signs. Certain signs of special interest to one person would be sought more carefully by that physician. As a result the incidence of some of the minor and questionable incidences of malnutrition vary considerably from one report to another. The occurrence of symptoms of necessity was investigated in a very rapid and superficial manner. As a result the incidence of the various symptoms must be taken only as an indication of the relative frequency of their occurrence. On the other hand the reliable evidences of nutritional deficiency such as oedema were sought with care and the weights, heights and laboratory findings were carefully checked and represent a fairly accurate picture of the group examined.

An attempt was made to evaluate the general state of the individuals examined according to the degree of thinness and appearance. Although this was possible only in the most general fashion and although other factors such as neatness and cleanliness were with difficulty kept out of the evaluation, it was felt that this procedure might be worth while.

The majority of the physical signs sought were quite straight forward and usual. All had been associated at one time or another with under nutrition in the minds of one or more workers in this field. Although it was by no means the opinion of the examiners that all these signs were indeed due to malnutrition it was felt that they should be sought and their presence recorded. One variation from the usual evaluation of these conditions occured in the case of cheilosis. All investigators had been struck by the number of individuals seen in the initial surveys with a mild to moderate degree of redness and swelling of the lips, particularly the lower lips, but without any evidence of actual cracking of the mucous membranes. It was conjectured by some examiners, particularly those who worked in Amsterdam and Utrecht, that this probably represented an early stage in the development of cheilosis and it was recorded on the examination forms as cheilosis grade 1.

Recording of cases with edentulous mouths and with dentures occured because the first of these can give rise to an angular stomatitis which is indifferentiable from that produced by nutritional deficiency and the second can produce papillary atrophy.

Only those cases of redness and oedema of the gums in which there was no acknowledged local cause for the inflammatory reaction were recorded; similarly in oedema only cases without marked varicosities or heart disease recognizable on this superficial examination were recorded.

At the conclusion of the physical examination approximately one subject in 10 was sent to another room where a dietist and a biochemist carefully interrogated them concerning the exact food eaten in the preceding 24 hours. This information was averaged at the end of the day and the intake of various nutrients for that period was estimated.

Every tenth to fifteenth person had blood taken from a finger prick on which estimations of total protein and haemoglobin were performed by the gravity gradient method of LOWERY and HUNTER.

In some of the surveys a sample of venous blood was taken on every twentieth person and returned each day to the mobil Nutritional Laboratory of the Oxford Nutrition Survey Group in Leiden Here, under the direction of Dr H M SINCLAIR estimations of total serum protein haemoglobin, vitamin A, carotene and ascorbic acid on whole blood was made

At the conclusion of the examination in each examining centre which, in the case of the morning examinations usually occured about 1130 hours, the patients ill in hospital or at home were visited and examined by the physicians

In addition to this evaluation of the nutritional status of these representative groups from the population, an attempt was made to determine whether any specific problem occured in institutions Hospitals, sanatoria, old peoples homes, orphanages and asylums in the city were contacted In most cases the contact was made in person by one of the physicians and a number of patients were examined

Because the information obtained from the dietary intake of the 24 hours preceding the examination reflected only the intake of food at the time of the survey and in no way represented the actual food intake which had produced the evidences of malnutrition, further information on food intake was required To obtain this information, the Chief Ration Official was asked for a list of the food actually supplied from the official rations and relief sources for October 1944 February 1945 and April 1945 These months were chosen because each represented a change in the food intake of the population From the beginning of the German occupation until the end of October 1944 there were few serious food deficiencies but it was immediately after this month that food supplies began their rapid deterioration In February 1945 food supplies had been reduced very severely and during this month the mortality rate was higher than at any other time Other factors such as lack of heating materials clothing etc undoubtedly played a large part in the mortality increase, and thus the true picture concerning food intake for this month seemed most desirable In April 1945 the termination of the German occupation was at hand and food stocks had almost been completely used

Because food which was obtained in excess of the legal ration played a most important part in the survival of the people, additional information concerning the total food intake was required To this end the services of the Chief of the Huishoudschool (housewiferyschool) in each city were obtained and through her activities careful inquiry was made into actual food intake during these same months on a total of 60—200 families

There were certain variations in the food intake and clinical evidences of malnutrition in the six cities surveyed The largest Western cities, Amsterdam and Rotterdam, were in the poorest condition, and Utrecht was the best The detailed data about the conditions found in each city are given in Appendix Nr 22, a brief summary is found in chapter VI, b

# VI RESULTS OF INVESTIGATIONS

## A SUMMARY OF THE REPORT BY THE PULSE COMMITTEE

### 1 *Introduction*

In 1941 there was set up in the Netherlands a Committee, known as the Pulse Committee an offshoot of the Food Council charged with the task of watching the nutritional state of the people Until its work was disorganised by the fighting on Dutch soil and restricted by lack of supplies it made periodical examinations of groups of the population with a view to assessing its conditions Unfortunately, these new circumstances prevented the members of the Committee from being able to study in an ordered manner what happened after the autumn of 1944 They were unable to resume coordinated work until after liberation in 1945 Accordingly the records of the work of the Pulse Committee do not throw much light on the rapid deterioration of health and physical conditions that occured after September 1944 and continued until relief came in May

The greater part of observations made by the Pulse Committee were accomplished in parts of the country outside of the Western provinces Thus the numbers of persons observed in the area later on known as the B 2 area are small and amount to approximately 10 % of the total number of individuals observed The studies of the Committee were very much disturbed in consequence of the difficult circumstances people lived in under occupation which caused suspicion of those interested in nutritional conditions and in many cases unwillingness to cooperate

The following short chapters give an abstract of the observations of the Committee in so far as they are of interest for the problem of starvation in Western Holland

### 2 *General Appearance*

A large number of indices have been developped to estimate the general appearance in one single figure Most of these indices have proved to be unsatisfactory

The Pulse Committee after carefully looking over the literature decided to adopt the Pelidisi formula of v Pirquet as an objective standard In this formula weight height and sitting height of every individual are measured and the index is defined by the formula

$$I = \frac{\sqrt[3]{10 \times \text{weight}}}{\text{sitting height}} \times 100$$

This index is stated to vary within narrow limits for all ages and both sexes in normal cases For muscular adults and fat infants it would rise to 100, for growing children to about 94 and in cases of serious emaciation it might fall to 81

Results with the Pelidisi index are collected in table 11*a* in which the average pelidisi numbers and their standard errors are mentioned separated according to sex, and agegroups at Amsterdam Rotterdam and The Hague in the first second and last period (May 41 May 42 and June 45)

The next table 11*b* shows the totals in both sexes separately for the towns together according to agegroup

TABLE 11A THE AVERAGE PELIDISI NUMBERS AND THE STANDARD ERRORS OF A NUMBERS OF PERSONS OF FAMILIES AT AMSTERDAM, ROTTERDAM AND THE HAGUE IN 1941, 1942 AND 1945

(p = Pelidisi index, S = standard error)

| Age | 0—6 years | | 6—14 years | | 14—17 years | | 17—21 years | | 21 year and older | |
|---|---|---|---|---|---|---|---|---|---|---|
| | p | s | p | s | p | s | p | s | p | s |
| Municipality and period sex | | | | | | | | | | |
| Amsterdam | | | | | | | | | | |
| May' *1941 female* | 94 | *1,47* | 92 | *0,54* | 92 | *0,97* | 92 | — | 99 | 0 63 |
| male | 96 | 0,83 | 93 | 0,66 | 95 | 0,58 | 94 | 2,43 | 97 | 0,90 |
| May *1942 female* | 97 | *1,20* | 92 | 0 67 | 93 | *1,34* | 93 | *0,34* | 98 | 0 75 |
| male | 95 | 1,41 | 93 | 1,25 | 94 | 0,58 | 95 | — | 97 | 1 09 |
| June *1945* female | 96 | 0,61 | 94 | 0,46 | 95 | 0,68 | 96 | 0,92 | 98 | 0 36 |
| male | 95 | 0,78 | 93 | 0,55 | 95 | 0,79 | 96 | 0,61 | 97 | 0,43 |
| Rotterdam | | | | | | | | | | |
| May 1941 female | 98 | 1,39 | 93 | 0,63 | 93 | 0,91 | 94 | 1,75 | 100 | 0 66 |
| male | 96 | 0,73 | 92 | 0,45 | 93 | 1,59 | 96 | 2,51 | 97 | 0,73 |
| May 1942 female | 94 | 0,71 | 92 | 0,63 | 91 | 1,33 | 97 | — | 98 | 0 85 |
| male | 100 | 0 57 | 92 | 0,48 | 97 | 0,47 | — | — | 95 | 1,24 |
| June 1945 female | 97 | 1,— | 95 | 0,51 | 96 | 1,05 | — | — | 98 | 0 58 |
| male | 97 | 0,81 | 95 | 0,49 | 97 | 1,24 | 98 | 0,75 | 97 | 0,69 |
| The Hague | | | | | | | | | | |
| May 1941 female | 94 | 0,82 | 91 | 0,42 | 93 | 0,83 | 93 | 1,08 | 97 | 0 39 |
| male | 93 | 1,18 | 91 | 0,41 | 93 | 0,66 | 94 | 0,78 | 97 | 0 46 |
| May 1942 female | 95 | 1,— | 91 | 0,60 | 94 | 1,19 | 97 | — | 97 | 0 62 |
| male | 94 | 1,27 | 92 | 0,50 | 92 | 0,81 | 92 | — | 96 | 0,56 |
| June 1945 female | 99 | 2,39 | 95 | 0,80 | 94 | — | 93 | 1,22 | 98 | 0,95 |
| male | 94 | 0,79 | 96 | 1,41 | 97 | 1,42 | 94 | — | 99 | 0,86 |

TABLE 11B THE AVERAGE PELIDISI NUMBERS AND THE STANDARD ERRORS IN THE TOWNS OF AMSTERDAM ROTTERDAM AND THE HAGUE TOGETHER

| Age | 0—6 years | | 6—14 years | | 14—17 years | | 17—21 years | | 21 year and older | |
|---|---|---|---|---|---|---|---|---|---|---|
| | p | s | p | s | p | s | p | s | p | s |
| May 1941 female | 95 | 0,73 | 92 | 0,34 | 93 | 0,57 | 93 | 0,90 | 98 | 0 38 |
| male | 95 | *0,66* | *92* | *0,30* | *94* | *0,45* | *95* | *0,95* | 97 | 0 38 |
| May 1942 female | 95 | 0,54 | 92 | 0,39 | 93 | 0,82 | 94 | 0,98 | 98 | 0,46 |
| male | 97 | *1,06* | 92 | 0,35 | 94 | *0,79* | *94* | *1,12* | *96* | 0,50 |
| June 1945 female | 97 | 0,50 | 96 | 0 36 | 95 | 0,61 | 95 | 0,90 | 98 | 0,29 |
| male | 95 | 0 55 | 94 | *0,48* | *96* | *0,69* | *96* | *0,72* | *98* | 0,35 |

The third table 11c gives the total numbers according to agegroups only

It is striking, that the Pelidisi-index 100 only occured in exceptional cases On the whole the index of 94, which was to apply to the growing youth, was not reached in 1941 and 1942 and was slightly exceeded in June 1945 This increase however is to be explained as an accidental difference

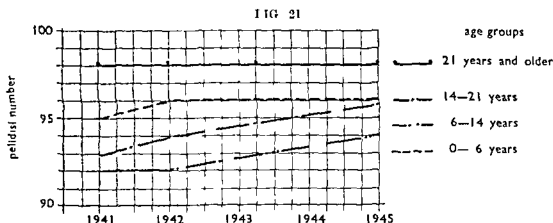
TABLE 11c

THE AVERAGE PELIDISI NUMBERS IN THE THREE TOWNS FOR BOTH SEXES

| Age | 0—6 years | 6—14 years | 14—17 years | 17—21 years | 21 year and olders |
|---|---|---|---|---|---|
| May—June 1941 | 95 | 92 | 93 | 94 | 98 |
| April—May 1942 | 96 | 92 | 94 | 95 | 97 |
| June—July 1945 | 96 | 95 | 96 | 95 | 98 |

Fig 21 shows that the average index was constant in adults, and increases in the younger age groups

FIG 21




In addition to this a subjective standard was used the Sacratama index of v Pirquet The examinations should be and were done by the same examiner to avoid personal influences In this index each of four syllables gives a judgement on one feature, the consonant giving the factor examined, the vowel expressing the state of that factor

S = sanguis (observed in conjuntiva palpebrae)

Cr = crassitudo (thickness of fatlayer under clavicula)

T = turgor (determined at upperarm)

M = musculi (upperarm)

The phonation tone of the vowel indicates the quality

i = particularly high

e = high

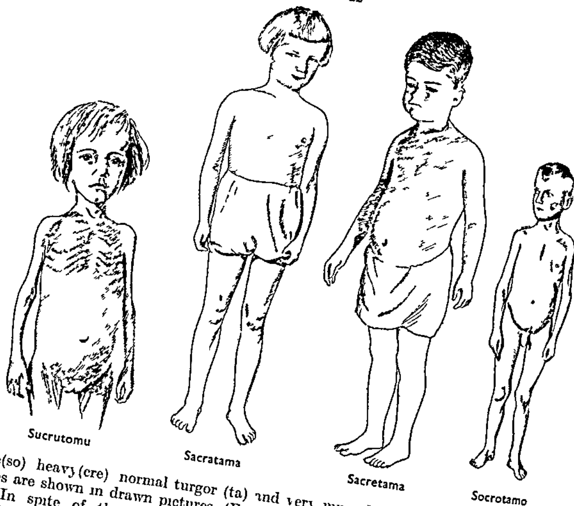
a = normal

o = low

u = particularly low

The combination of these consonants and vowels results in a word by which the nutritional state can be characterised immediately Thus "soeretami" means

FIG 22



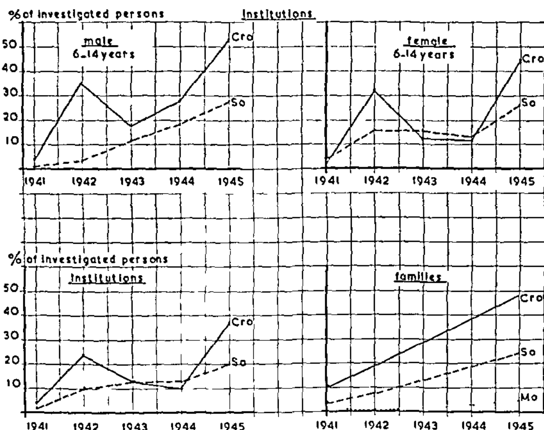

pale(so) heavy(cre) normal turgor (ta) and very muscular(mi) Examples of some types are shown in drawn pictures (Fig 22)

In spite of the drawbacks of this method (influence of subjectivity) some conclusions could be made

The crassitudo determinations show a considerable increase of thin persons (Cro fig 23) From this curves it seems to be obvious that the number of thin persons decreased in the years 1943 and 1944 This fact is not easy to explain and may be the result of two different influences The first rapid decrease in food intake was in 1942 and in consequence there was a decrease in average body weight The food situation then was constant for some years and the body became adapted to this condition which resulted in some improvement in the physical status The next important decrease in food intake occured in 1944 with the same effect The two peaks in the curve are only observed in the graph for persons in institutions and not in the curve showing the results in the family examinations With regard to the subjective base of these estimations the two peaks might be of accidental origine persons in private life (families) however had more possibilities to get food apart from their rations The institutions followed much more closely the actual food rationing and this might be responsible for the difference in the two curves

From fig 24 can be seen an increase of the number of heavy persons(cre) at the

FIG 23




beginning of the rationing An explanation of this feature is probably the following the unemployed group and paupers from the period before occupation fared relatively well during occupation the total amount of food contained in the ration was more than they had before

The results of the determinations of the other conditions (sanguis, turgor and musculi) are also shown in the block graphs of fig 24

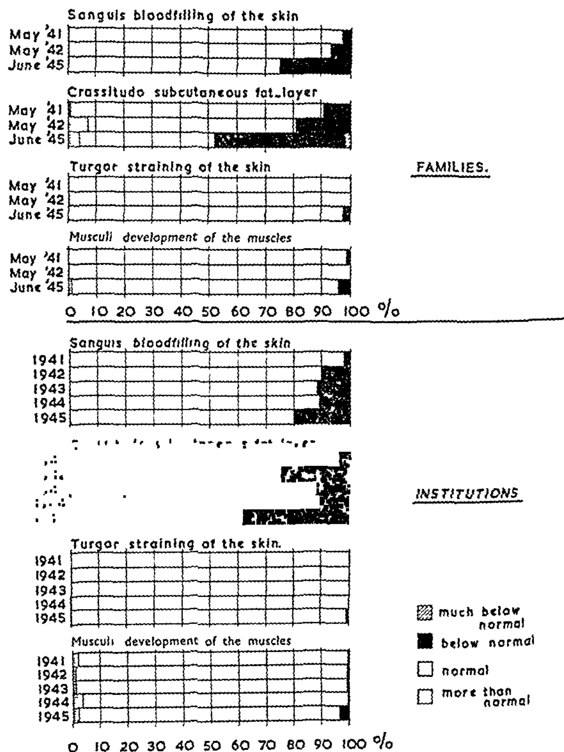
Comparing the results of pelidisi and sacratama examinations it can be concluded, that pelidisi indices are not satisfactory as a static indicator, either for the individual or for the whole population

The sacratama gives a quite different impression, more corresponding with reality

It was shown that sacratama results were worse in the older age groups

From the determinations of height, sittingheight and weight, the conclusion could be made that on the average there was decrease in lenght (difference 2 to 4 cm) This was observed more clearly in the younger agegroups (0—12 years) but still could be found in the older agegroups (12—21 years) In sitting heights the picture was not constant This difference in height showed a slow restoration after liberation Weights were restored much more quickly The phenomenon may be explained partly by a retarded length growth, and partly by muscular atony

*FIG 24* Nutritional position according to the Sacratama method by VON PIRQUET with both sexes and all ages in Amsterdam, The Hague and Rotterdam in percentages from the total number examined persons



### 3 *Clinical examinations*

The clinical features collected during the surveys in the periods 1941, 1942 and 1945 are shown in Appendix Nr 23

For the discussion of these clinical signs is deferred to the clinical and pathophysiological assessment and the survey reports

### 4 *Dental examinations*

In a group of 452 individuals in the Western area (Amsterdam, Rotterdam and The Hague) a careful examination of the dental conditions was carried out This examination included the number of teeth present and the number of carious elements (filled and not filled) Further details were noted about conditions of the mouth (orthodontal changes, condition of gums etc) dental hygiene, etc

Only the records of the 6 to 13 year old children permitted statistical treatment, from which details are given in table 12

TABLE 12

| Dental conditions | Average number of teeth | |
| --- | --- | --- |
| | Period I (1941) | Period II (1945) |
| Normal | 16 7 ± 2 2 | 17 4 ± 1,9 |
| Carious | 4 9 ± 1 7 | 4 5 ± 0 9 |
| Filled | 1 4 | 0 8 |
| Extracted | | — |

Although a significant difference is not observed, these results point in the direction of an improvement of dental conditions after occupation There is evidence of a similar trend in reduction of dental defects in Great Britain where, special attention was given to children during the war similar observations have also been reported from France Russia Belgium and Switzerland

### 5 *Dark adaptation tests*

The method followed in the determinations dealt with in this section, was the method described by Kentgens The retina of the subject is first adapted to light of a constant and known intensity for 6 minutes The threshold is then estimated with the Kentgens adaptometer (appendix Nr 24*a*) and measured in millilux Darkadaptation is then begun and further estimations are made in 3, 5, 10, 15 and 20 minutes The results are plotted in a graph the adaptation curve Every adaptation curve is compared with a standard curve, obtained as an average of 20 normal subjects A bloodsample was also taken for vitamin A analysis Persons examined included rural and urban inhabitants from the provinces N and S Holland and those living in institutions Periods of observation were 1941 and 1943

In Appendix Nr 24*b* the data are divided into percentages of persons with a normal curve with an abnormal threshold either at the beginning or at the end of adaptation, with a totally lowered curve and with real nightblindness

As a rule there was better adaptation among women than among men, though the difference is not statistically quite significant

Adaptation in the families and in the institutions did not show a marked difference in the years of observation, though there was some more real nightblindness found in the institutions (Appendix Nr 24c)

No marked deterioration could be shown in the dark adaptation during the time of observation (1941—1943) Neither were significant differences observed between the populations in urban and rural districts

It was also observed that there was no definite relationship between vitamin levels and darkadaptation (Appendix Nr 24d)

### 6 *Tuberculin tests*

Tuberculin tests were performed on children in institutions Furthermore the results of the Amsterdam Dispensary were available

The method used was the test of v Pirquet (scarification with special drill) Human tuberculin was used and the reactions read after 48 hours by comparison with a control Results are given as arithmetical averages in table 13 and 14

TABLE 13

AVERAGE RESULTS OF THE PIRQUET TESTS IN 7 INSTITUTIONS AT AMSTERDAM ROTTERDAM AND THE HAGUE (in %)

| Period | Number of persons examined | Negative reactions | Weak positive reactions | Strong positive reactions |
|---|---|---|---|---|
| 1941 | 900 | 71 | 8 | 21 |
| 1942 | 889 | 75 | 8 | 17 |
| 1943 | 952 | 79 | 1 | 20 |
| 1944 | 729 | 83 | 2 | 15 |
| 1945 | 757 | 92 | 3 | 5 |

TABLE 14

PERCENTAGES POSITIVE PIRQUET REACTIONS AT AMSTERDAM (no contacts of known open cases)

| Age | 1936—1940 | 1941—1943 |
|---|---|---|
| 1 year | 16 2 | 15 1 |
| 1—2 | 12 6 | 13 9 |
| 3—4 | 21 8 | 12 5 |
| 5—6 | 26 6 | 15 0 |
| 7—10 | 31 8 | 21 3 |
| 11—14 | 44 6 | 35 1 |
| 15—19 | 56 0 | 46 3 |
| 20—29 | 77 0 | 70 3 |
| 30—39 | 88 1 | 88 4 |
| 40 year and older | 90 0 | 87 9 |

As seen from these data it is striking that during the occupation the percentages of positive tuberculin tests *decreased* Meanwhile the number of sources of infections increased (compare increase of morbidity of open cases and of tuberculosis mortality)

The explanation of this fact is not absolutely clear Changes in sensitivity caused by nutritional and health factors will probably have influenced the reactivity

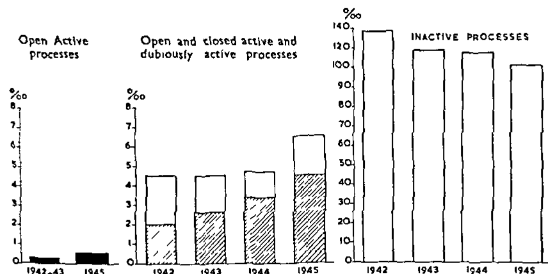
of the individuals This would explain the findings, that the strong reactions show a less considerable decrease than the weak reactions (Appendix Nr 25)

On the other hand the figures and graphs from Appendix 25 show that there may be a lag of 1—3 years between the curves of tuberculosis morbidity and that of positive tuberculin tests

### 7 *X ray examination of the thorax*

This chapter is based on the observations of the Central Office for Medical Hygienic Examinations at the Hague (Director Dr ORBAAN) The observations were made by experienced specialists the method used was fluoroscopy

FIG 25 Course of the number of t b processes during and immediately after the war

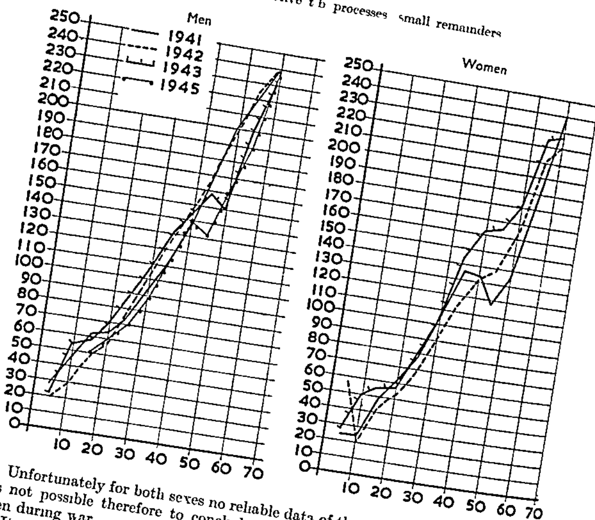



The results from about 50 000 observations per year are recorded in fig 25 From this blockgraph it is obvious that the number of active open and closed cases increased considerably and the number of inactive cases decreased during the time of occupation A further analysis is given in fig 26 dividing the material into sex and agegroup The curves from men show a regular rise with age till 1942, from 1943 a break is observed, however, in the agegroup of 50 years (1943) and 45 years (1945) This break can hardly be explained in any other way, than by an increased number of reactivations at this and more advanced ages This symptom is in accordance with the high peak in the curve of active and dubiously active cases, which will be mentioned later

The difference at the younger age must at least for the present, be considered as accidental

Among women we also observe a similar break in the trend, however on an earlier date (1941) In the graph for women it does not show a shift to a younger age with the advance of war, as was the case in men Moreover this phenomenon becomes less and less visible For this group as in men, differences at younger age are to be considered as accidental

FIG 26 Inactive t b processes small remainders




Unfortunately for both sexes no reliable data of the pre war years are available it is not possible therefore to conclude whether we have to do with a symptom arisen during war

It must be borne in mind that the persons examined were a random sample of the population in so far as it consists of people considering themselves as reasonably healthy

The patients *known* at the t b control stations were only in part contained in this group In the Amsterdam survey for example the rate of active cases known to the Dispensary amounted to about 3 5 ‰ whereas the rate of unknown cases found by mass X ray methods was about 2 5 ‰ Forty percent of the total number of active cases was therefore unknown to the Dispensary This figure must be looked at as an approximate one

Studying the figures of mass examinations only shows the reactions of the morbidity therefore only for a part and so to speak in miniature

From fig 25 it is obvious, that active cases increased considerably during occupation When we take active and dubiously active cases together we observe however no clear change until the end of 1944 The differential diagnosis between active and dubiously active cases was made by experienced observers, following for a long time the same criteria We may take it therefore as probable, that the

increase of the active cases for the greater part took place at the cost of the other group and not in the first instance as a result of a rise in the rate of infection

In the provinces North and South Holland the increase of active cases was about 100 % for open and closed cases

Fig 27 shows the influence of age on tuberculosis morbidity A high peak in the age groups 40—60 years is observed in the curve for the year 1945 in both sexes The straight lines (regression lines) show the general trend of the increase with age for active processes this increase is more marked in 1945 than in 1942

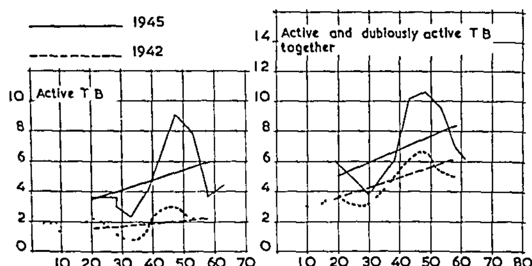



FIG 27 Influence with men of the circumstances of war on the course of the number of active and active + dubiously active t b processes divided according to age

Remark I The straight so called regressive lines show the general tendency of the original lines through which they have been drawn

Remark II The curves of the active and active + dubiously active t b processes have been calculated from every 2 consecutive 5 year age classes

Tuberculosis mortality rates are reproduced in fig 28 it appears that the type of the graphs remains the same every year and shows peaks at about 25 and 65—75 years This last peak, however has a tendency to a more rapid increase during the occupation

B SUMMARY OF NUTRITION SURVEYS

Results of the *rapid surveys* are in brief summarised for each city (For details see Appendix Nr 17)

*Utrecht* 8 May 1945 Population 150 000 Estimated number of cases of serious starvation 400 150 persons examined of whom 47 % were thin, 7 % very thin 6 % had famine oedema

Estimated weight loss among the adult population — 30 lbs

The less clear cut evidences of nutritional deficiency were also sought *Angu-stomatitis* was very rarely seen in much less than one per cent of the populati[on] examined *Cheilosis* as usually described with fissuring of the lips was an extremel[y] rare finding However a peculiar redness and swelling of the lips usually the lower was a very common finding in the childhood and adolescent groups

True *glossitis* involving the entire tongue and presenting the typical red beefy appearance occured rarely However localised areas of redness and enlargment and swelling of the papillae were common *Papillary atrophy* was exceedingly common in the older people and was found even in infants In the adult group it was found in 25 or more per cent of all examined

*Oedema of gums* and *redness of gums* without evidence of malocclusion or other local factors which could produce the lesion were found in 5 to 25 per cent of the adolescent age group and much less commonly in other groups *Purpuric manifest-ations* of any sort occured with great rarity as did other evidences of haemorrhagic tendencies *Folliculosis* and *follicular hyperkeratosis* occured with considerabl[e] frequency in the childhood and adolescent age groups and much more frequency in females than males *Dry skin* and *crackled skin* occured in all age groups and increased with age It seems significant however that in the childhood and adolescent age groups the signs occured in 5 to 10 per cent of those examined Peculiar pigment-ation was occasionally seen in Western Netherlands — patchy areas of brown pigment on hands arms and chest most frequently but occasionally seen in the mucous membranes of the mouth The lesion was seen usually in oedematous or severely cachetic persons *Pallor* was a common finding in all groups occuring in 15 to 20 per cent of all examined *Muscle tenderness* was relatively uncommon and increased with increasing age *Blepharitis* was a rare finding *Pinguecula* was commonly found in the older age group and much more common in males than females *Suborbital pigmentation* was exceedingly common particularly in the children examined

The laboratory examinations reveled relatively little Average *total serum protein* was within normal limits but in the lower range of normal A number of such determinations were done on cases of famine oedema in an institution and although the average of this group was below the general average in no individual case could the total protein level be taken as an index of the degree of famine oedema The *haemoglobin* levels tended to be low and varied between 12 5 and 13 5 g for most groups Average *Vitamin A* levels fell within the normal range with very few below and *carotene* levels were definitely in the high part of the normal range This latter was probably due to the fact that in the ten days prior to liberation the first green vegetables of the year were distributed and were avidly consumed by the population *Ascorbic acid* levels on whole blood varied widely and averaged about 0 4 mg per 100 cc

In addition to symptoms and physical signs the observers obtained an impression that the psychological state of the population was not normal at time of liberation There was a tendency to mental cloudiness a desire to dodge issues rather than face them squarely This impression was fortified by a change in a period of a month after occupation with a return towards clarity and briskness of [illegible] and action

*Mortality Statistics* in all cit[illegible] indicated a [illegible] rise during the past six months The high [illegible] for Fc[illegible] in some

cities the rate was three times the usual for that month The mortality rates had dropped somewhat after February but until liberation, were maintained at approximately twice normal A much greater percentage than usual of the deaths were among the aged and among males The infants mortality figure showed a similar but less marked rise

An attempt was made to obtain evidence relative to child health Generally there was little if any, reduction in birth weights or lengths It seems that only slightly fewer mothers than usual could begin nursing their babies but that many more than usual lost their supply of milk in the first two of three months The *incidence of still births was little if any changed and there seemed no reliable* evidence of increased prematurity Complications of pregnancy were said to have decreased particularly the incidence of toxaemia

The incidence of infectious disease varied considerably during the years of occupation It is believed that tuberculosis had markedly increased

In summary the picture obtained by the surveys in the Western Netherlands indicated that the inhabitants of this country suffered relatively mildly from food lack during the years from 1940 until October 1944 During this period, their food intake was insufficient to maintain them in comfort and was always monotonous, but did not result in serious evidences of malnutrition or starvation except in a very small percentage of the population From October 1944 the amount of food available for distribution had rapidly decreased and despite the utmost efforts of the food administrators and the people themselves the general health of the population deteriorated considerably The aged the very poor and the occupants of institutions rapidly developed serious evidences of famine and among these groups deaths from starvation occured Near the conclusion of the German occupation, a new phase was beginning one in which despite the best efforts of everyone concerned the dietary intake was falling to a level, where all age groups would soon show gross evidences of food lack If this phase had continued for a few weeks or months it is to be expected that the mortality rate would have increased very rapidly and deaths from starvation would have been common This major catastrophe was averted by the timely German surrender and the distribution of food by Army and civilian authorities This was followed by an unbelievably rapid change in the population, with great improvement apparent within one month

On the basis of these surveys including the response to one month of refeeding, it was found that the population of the Western Netherlands maintained itself in reasonably good health for a period of four to five years on a caloric intake approximating 2000 calories daily True, a loss of weight and activity ensued but general health was maintained With subsequent restriction of calories, health deteriorated rather rapidly with considerable evidence of actual starvation Refeeding at levels of 2000 to 2500 calories resulted in a prompt and all around general improvement in health While bodyweight was not fully or promptly restored, improvement in morale and well being was evident within a week to 10 days and greatly improved after a period of one month However, recovery to a stage where physical activity may be normal or above and to regain normal resistance undoubtedly requires longer period, great caloric intake, and a diet to furnish vitamin, mineral and protein in adequate amounts

The main results of these extensive surveys are shortly mentioned in the following (for details see Appendix Nr 22)

*Delft May 21—26th*

It was notable that there had been a marked improvement in the appearance of the population during the past three weeks. The total number of persons clinically examined was 1804, approximately a 3 % sample of the total population. Of those examined 810 (45 %) were from the lower economic levels, 779 (43 %) from the middle and 225 (12 %) from the high income groups. Certain complaints such as undue fatigue, weakness, muscular pains and diarrhoea occured with almost equal frequency among all three income groups. There were notable differences however in the physical state at different income levels. Only 3 % of the poor were well nourished. 8 % of the lower income group were seriously emaciated, 11.5 % had oedema attributable to underfeeding and the average number of physical signs of malnutrition observed in this group was 4.5. In the middle class group 25 % appeared well nourished, only 0.5 % were emaciated, 2.6 % had oedema and the average number of physical signs of deficiency disease was 3.5. Of the high income group 48 % were well nourished and 1 % emaciated. Oedema occured in only 1.1 % and the average number of physical signs was 2.

The majority of haemoglobin and serum protein values were in the range of 12 to 13.5 grams and 7 to 7.8 grams respectively regardless of the social class and age.

Daily calory and protein intake for the different periods were approximately:

| | calory | protein |
|---|---|---|
| October 1944 | 1600 | 40 g |
| February 1945 | 1000 | 33 |
| April 1945 | 1100 | 26 |
| 18—26 May 1945 | 2000 | 50 |

These finding confirmed the results of the rapid survey previously made in Delft and emphasize the unequal distribution of serious starvation among the different economic levels.

*Rotterdam 29 May—8 June 1945*

In the nutritional survey of Rotterdam conducted between May 28 and June 8 1945 a total of 2660 people were examined in street clinics and approximately 185 examined in some 20 representative institutions. Most of the hospitalized hunger patients were concentrated in the so called emergency hunger hospitals and hardly without exception these patients showed severe cachexia. Patients in other institutions did not present a major problem in underfeeding.

In grading the general appearance of the people examined in the street clinic approximately 40 % of the poor people were judged normal, 50 % of the middle class and 80 % of the upper class. Weightloss averaged about 25 pounds in the group from 19 to 59 years of age and 40 pounds in those over 60 years, with females showing slightly more loss.

The symptoms of diarrhoea, fatigue, weakness, muscle pain and paraesthesias were prevalent in all groups though more so in those from the poor group.

Papillary atrophy, pallor and folliculosis were the commonest clinical findings of nutritional interest occurring in 20 to 60 percent of the people and to a greater degree in those from the poor districts. Oedema was present in about 3 % of the people in the 18 to 50 year group from the poor districts and roughly 12 % of those

over 60 years of age. This showed a considerable drop in the incidence of oedema as compared with the 18 percent incidence observed in Rotterdam 4 weeks prior.

The haemoglobin and serum protein values mostly required from 12 to 14 g and 7.0 to 7.6 g respectively.

Daily calory and protein intake for the different periods were approximately:

| | calory | protein |
|---|---|---|
| October 1944 | 1400 | 40 g |
| February 1945 | 800 | 26 „ |
| April 1945 (Red Cross) | 850 | 24 „ |
| 29 May—8 June 1945 | 2400 | 70 „ |

*Amsterdam May 23 to June 3*

*The nutritional state of the population of Amsterdam as shown by this survey* revealed serious evidences of malnutrition. Only 41.1 % of the population presented a normal appearance. 41.0 % were thin. 16.3 % very thin and 1,6 % emaciated.

If the survey can be taken as typical of the city generally, this represents an incidence throughout the city of 320 000 thin, 320 000 normal, 130 000 very thin and 12 000 emaciated.

The incidence of oedema was high in the representative group examined and if the data can be considered as typical there must have been at the time of the survey about 56 000 cases of oedema in the city of Amsterdam.

The mortality statistics for the city showed an increase during the winter months. This increase was probably due in part to underfeeding but in large degree to exposure and lack of fuel.

The heights and weights of subjects from 2 to 18 years of age showed a slight increase with improvement of social group. The average heights and weights in 1945 for the age group 7—14 years was slightly if at all lower than average weights and heights in 1939.

Less reliable evidences of nutritional deficiency occured with varying degrees of frequency in the groups examined.

There was little laboratory evidence of malnutrition found. Average vitamin A levels fell within normal limits and average carotene levels were high. Ascorbic acid in whole blood averaged about 0.5 mg and was definitely below the desired figure of 0.6 mg. Total proteins were all within normal limits but the haemoglobin usually fell below the desired level of 15.6 mg per cent.

The dietary analysis in the survey revealed a daily calory and protein intake for the different periods as follows:

| | calory | protein |
|---|---|---|
| October 1944 | 1800 | 60 g |
| February 1945 | 1200 | 45 „ |
| April 1945 | 1000 | 25 „ |
| 23 May—June 3 1945 | 2400 | 80 „ |

All evidence points to the fact that the inhabitants of the city of Amsterdam had suffered only slightly from lack of food from May 1940 until October 1944. However, during the months between October 1944 and May 1945 food supplies

deteriorated rapidly and the population suffered with increasing severity from lack of food

The signs, which are apparent after these few months of severe underfeeding indicate that the general health of the population deteriorated rapidly and that if the underfeeding had continued for a period of weeks or months a major catastrophe would have resulted

*Utrecht, June 6 to 12*

This survey performed on the population of Utrecht approximately one month after the termination of the German occupation, revealed some incidences of nutritional deficiency The evidences were not as severe as in the case of Amsterdam because conditions were more favourable for obtaining additional food in Utrecht than in Amsterdam Also more time had elapsed between the cessation of German occupation and the beginning of the survey in Utrecht During this time increase in the amounts of food provided, had caused a rapid improvement in the physical state of all inhabitants of the Western Netherlands

If the subjects surveyed can be considered as representative of the city generally, there were 50,6 % or 90 000 inhabitants who present a normal appearance, 41,8 % or 70 000 who were thin, 6 9 % or 12 000 who were very thin and 0 7 % or 1000 emaciated

Oedema to a mild degree was found in 2,8 % of the subjects examined If the group is representative, this implies a total of approximately 5000 cases of oedema at the time of the survey

The heights and weights of subjects from 2 to 18 years of age showed a definite increase with higher social levels The average heights and weights of children from 6 to 13 years show a decrease in 1945 as compared to figures obtained on school children in 1939 The discrepancies between the weight levels are the more marked when one considers that the 1939 weights were obtained on children without clothes, whereas the 1945 weights were obtained with only outer clothing and shoes removed

Less reliable evidences of nutritional deficiency were found with varying degrees of frequency in the groups examined

The laboratory results showed normal average levels for total protein and vitamin A, high average levels for carotene and below desired levels for vitamin C and haemoglobin

The general mortality and children's mortality statistics from Utrecht show a decided increase in the number of deaths in all age groups during the period from January 1st to May 30 1945

The dietary analysis in the survey reveals a daily intake from both calories and protein as follows

| | calory | protein |
|---|---|---|
| October 1944 | 1700 | 60 g |
| February 1945 | 1400 | 50 ,, |
| April 1945 | 1300 | 36 ,, |
| 6—12 June 1945 | 2100 | 66 ,, |

The evidence obtained from the survey in Utrecht indicated that this city suffered less from the effects of underfeeding than any of the other four cities

surveyed The prevelence of cachexia and oedema on the original one day survey immediately after liberation was much higher than in this more detailed examination The marked difference between the results of the two surveys is due to the response of the population to the increase food intake provided The rapidity of this response was far beyond that which was anticipated

*Main Surveys in Leiden and The Hague (Oxford Group team C)*

Headquarters at Leiden on May 24 where arrangements had been made to work at the Universiteits Laboratorium voor Medische Chemie The team (C) was equipped with two mobile laboratories and was prepared to make clinical, physiological biochemical and bacteriological studies valuable assistance and consultation was given by Dr W A S DEKKER conservator of Medische Chemie, and Dr v EEKELEN Director of Central Institution for Food Research of Utrecht and his Staff

The numbers were considered sufficient to give a representative sample of the population The main signs and symptoms encountered were those of caloric deficiency rather than specific clinical deficiencies As in the other surveys, weightloss oedema and diarrhoea were the most serious problems

It was decided, that since the conditions were rapidly improving team C should place particular emphasis on laboratory aspects of the survey

Approximately 25 000 laboratory determinations of nutritional factors in blood, urine mothers milk and other samples were made This included samples collected by survey teams A and B About 90 of these determinations were made by the Dutch workers In addition to these tests for night blindness skeletal X rays, and the response to specific therapy were studied The team C ceased work July 2

*Review of findings in Leiden and The Hague*

The Survey of *Leiden* a city of 80 000 began on May 24 and completed on June 1 The total number of persons examined was 1031 In Leiden oedema was found in about 15 % in the lower economic group 10 % in the middle group and 20 % of the higher group the men being more effected than the women During the first few days in Leiden the official rations approximated 630 calories per day and in following week 2000 appearing to be adequate for normal requirements in all age groups

The Survey in *The Hague* population 600 000 extended from June 4 to June 11, with a total of 1486 persons examined from all economic groups Oedema was found in 30 % in the group with lower income 13 % in the middle and 23 % in the high class The average costumer received approximately 2500 calories in that week

Detailed data relating these surveys are found in chapter VI, c 3

C CLINICAL FEATURES OF STARVATION

Dr C L DE JONGH The Hague

Compiled from the reports of Dr STOLTE Amsterdam Dr DIKKENBERG Amsterdam, Dr DROOGLEVER FORTUYN Amsterdam Dr DE JONGH The Hague, Dr SOETERS The Hague, Dr BOK, Rotterdam Dr JONXIS, Rotterdam Dr HULST, Utrecht and the reports of the leaders of the Medical Feeding Teams

The cases admitted to hospital after the liberation could be classified as follows

- a very severe cases of starvation who were too weak to leave their houses or who if they did collapsed in the street
- b moderately severe cases who were ambulant and therefore of a type that would have been included in the street surveys
- c complicated cases in which the prime cause of admission was more likely to have been due to the complicating disease rather than the malnutrition *per se* many of these also were ambulant

Thus only the cases with very severe complications and the grossly starved would not be included in the street surveys The general impression was that the latter type of case presented few qualitative differences from the moderate cases the differences in the objective physical signs were of degree only

Of the cases admitted to hospitals the majority were in the age of 50 and over The more exact distribution of age groups in hospital cases is given in table 9 (chapter V c)

The reasons why these groups were most represented are probably that they were the least well able to fend for themselves and that they were the most prone to be laid low by the complications of starvation especially diarrhoea and infections of the respiratory tract

The children are considered in a later section Amongst the adults the following points were noted

I *Sex* Far more men than women were admitted to hospital for special treatment

II *Social status* The cases were mainly of the lower income and social class It was notable that there were a considerable number of the vagrant class of low mental capabilities There was a strong suggestion that these and others with limited wits had not the drive and ingenuity to make the best of circum stances too difficult for them

III *Civil status* Many of the cases were elderly bachelors widowers spinsters and widows living alone or on pensions Such people had only themselves to rely on They were able to draw only the official ration The family with several adolescent children were the best off in making the best use of official rations because youngsters could forage for food in the country

### *Case histories*

Almost without exception the first thing noted and the chief thing complained of by the patients was of *hunger* This hunger became a torment to them day and night In so far as they were interested in anything this interest was directed to the getting of food Sometimes food formed the subject of their dreams Only very rarely was the appetite diminished or absent and then only in the very severe cases Another general complaint was of *fatigue* both *physical* and *mental* As a result of starvation even the young and normally vigourous people reached a state in which they shrank from any exertion Physical fatigue caused them to be unsteady on their feet they were liable to falls and were apt to stumble and drag their feet they became clumsy and could hold objects only with difficulty Mental fatigue resulted in failure of concentration and decline in memory

Complaints of *pains in the limbs* were a common place. Women in particular complained of pain in the back. Many people suffered severely from dull, *burning sensations* in the *hands* and *feet*. These paraesthesiae persisted for a considerable time after the improvement in the diet.

A relatively early complaint was of *dropsy*. Preceding actually visible dropsy was a period of noctural *frequency of micturition and polyuria*. This was followed by noticeable swelling of the feet in the evenings. This would subside in bed to be replaced by puffy eyelids in the early morning. This in turn disappeared during the daytime. Even when the swelling became more marked, it would disappear with a longer stay in bed. It was exacerbated by extra exertion, but by itself this swelling was not considered by most people a sufficient cause for not going to work or carrying on.

The frequency of micturition was much greater than in normal times. It was especially noted at night and this had been generally noted even before the severe food restriction of the starvation period. Precipitancy of micturition was common.

A very general and major complaint was of coldness. In the winter months when fuel was lacking, it was a real torment.

Some patients were troubled with dry and painful mouths and with difficulty and pain on swallowing.

As a rule defaecation was normal. Practically every patient, however, at some time or other suffered with diarrhoea of longer or shorter duration. It led frequently to incapacity and prostration.

In men there was often a decline in libido and even impotence. Many women had *amenorhoea*.

At night sleep was superficial and brought no refreshment; in the daytime many were sleepy and apathetic.

There were some complaints of failing vision and night blindness, but serious visual impairment was uncommon. There were still fewer complaints of auditory failure.

### *Clinical signs*

The most marked sign noted in those suffering from severe underfeeding was the appaling emaciation, the hollow jaws, the sunken eyes, the wasted limbs and the prominent ribs. Fig. 29, 30 and 31.

The skin was sallow and frequently showed a dun brown pigmentation either all over the body or restricted to the exposed parts. Occasionally the pigment was restricted to a special neuro segment and scattered pigmented areas also occured, fig. 32. On the other hand vitiligo was noted in a few patients and by some was considered a sign of a grave prognosis, fig. 33. Cutaneous lesions suggestive of pellagra, a butterfly shaped itching erythema of the cheeks and chin, which healed, leaving marked pigmentation, were very occasionally seen; sometimes this erythema was confined to the nose. Frequently the skin was dry and scaly with a tendency to hyperkeratosis giving it a rasplike appearance. The frequent occurence of impetigo and of suppuration in skin wounds pointed to a diminished resistance of the skin to infection.

Pronounced acrocyanosis and chilblains of the hands and feet were common. Necrosis of one, two or more toes was also frequent. (Fig. 34)

Specially in the older patients skin haemorrhages were often seen These took the form of petechiae in the lower parts of the legs, particularly when oedema was present, or of larger dermal extravasations, often symmetrical, on the extensor surfaces of the forearms and lower legs, on the backs of the hands and in the temporal regions

In many, a sign that made the greatest impression was oedema of the skin, so that the word hunger oedema was often used as a generic term, to cover all the features of the starvation picture The oedema was most often seen in the region of the ankles and secondly in the face (Fig 35 ) All degrees were noted, from a very slight swelling behind the ankles which only appeared when the patient had walked or stood for a long time, to the very extensive and obstinate oedema of the lower parts of the body, including the abdomen The external genitalia were often considerably swollen with oedema fig 36 The facial oedema often resembled that of a severe case of nephritis When it was slight, however, it was often difficult to decide whether there was oedema or not In such a case reference could be made to the conjunctivae Chemosis, a sign that is easy to detect, if present, was regarded as confirmatory of oedema Sometimes the facial oedema was confined to the lower eyelids giving a characteristic "water bag" appearance under the eyes The subcutaneous oedema in general was easily displaced and deep pitting was produced in the skin by pressure fig 37 The distribution of the oedema fluid was greatly influenced by gravity and thus was maximal in the leg at the end of the day and in the face in the early morning Only in the exceptional, severely oedematous case was oedema found on the backs of the hands and in the lower arms

Pediculosis corporis and capitis was extremely common, so that excoriations of the skin were frequent Scabies was also common

The nails on the whole were not abnormal, though some ridging and cracking were seen A proportion of subjects showed a distinct yellow pigmentation of the nails

*Cerebral functions*

Most patients showed a great lack of initiative and energy They shrank from the slightest exertion both physical, and mental They were slow in answering questions and their memories were poor Some did not even remember their ages and had difficulties in stating their addresses Impairment in consciousness was observed from minor degrees to somnolence and coma Along with the apathy, some parodoxically showed a marked irritability, which led them into flaming quarrels over futilities

There were others, who far from showing alack of initiative in spite of their undernutrition, would undertake long and strenuous journeys to procure food The urge to procure food might even become so great that people, who in normal times were strictly honest, came to stealing food

In some cases a psychosis developed in which delirium, paranoid traits and hallucinations were the most common signs Owing to this psychotic change, but rarely some refused food and had to be forcibly fed

*Nervous system*

Objective signs of disturbance of the nervous system were comparatively rare The reflexes were usually normal, sometimes the tendon reflexes were reduced or

absent in other cases increased reflexes were noted Romberg's sign was consistently negative

Some cases of paresis of the N peronaei were observed and occasional cases of polyneuritis and degenerations of the sensory tracts of the spinal cords It remains to be seen whether these cases had a cause connected with the underfeeding A similar doubt remains of a connection between malnutrition and herpes zoster, which was seen with some frequency DROOGLEEVER FORTUYN considered hyperaesthesia in the lower neck and upper chest segments and also in the groin region, or a hyperaesthesia on the border of two segments as significant

In some cases the hyperaesthesia was associated with a segmental pigment deposit (fig 38)

*Muscular system*

In general the muscles were very atrophic after prolonged underfeeding The weakness of the muscles was shown in the slow and laborious way the patients moved Increased myotatic irritability of the muscles was seen Myoedema, a swelling which appears on tapping the muscle belly and lasts for 5 to 8 seconds (idiomuscular contraction lump of Schiff) was seen in some cases STOLTE noted that the occurence of this phenomenon was not abolished by anaesthetization of the nerve supply to the muscle

*Body weight*

In the majority of cases the body weight decreased often alarmingly There were those whose weight decreased from 45 % to 56 % below normal, purely from starvation Of the out patients who visited the polyclinics in both sexes the vast majority showed a decrease of body weight of more than 25 $^{\circ}/_{0}$ Men as a rule wasted more than women There were indeed some young women such as have been reported in France, who in spite of the underfeeding actually gained in weight and this paradoxical increase in weight could not be put down to visible oedema

Many of the emaciated people suffered from oedema so that their body weight was considerably greater than their true weight The degree of emaciation did not always run parallel to the extent and intensity of the oedema

STOLTE reports the following figures about body weight Table 15 and 16

*Body temperature*

In the severe cases the body temperature tended to fall below normal Temperatures below 33° were reported in the cold weather Dr MINJER recorded body temperatues as low as 27° in those exposed to severe cold and undernourished In the first few days of diseases like pneumonia some patients still had temperatures below normal

*Digestive tract and abdomen*

The mucous membrane of the mouth and throat tended to be pale The commonest sign to be seen in the tongue was a mild or moderate degree of papillary atrophy Complete atrophy with a smooth and shining dorsal surface was, however rare Sometimes there were red painful patches on the edges and dorsal surface When the patient had diarrhoea the tongue was dry and furred In some cases apthae were found in the mouth and pharynx Occasionally rhagades were seen at the corners of the mouth

TABLE 15 WEIGHT OF 20 STARVATION PATIENTS

| | Age | Height | Ideal weight | 1940 weight | Lowest weight | 5 Aug '45 weight | Oedema | Shortage of weight | | Weight loss | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | year | m | kg | kg | kg | kg | kg | kg | % | kg | % |
| Male | 73 | 1,71 | 71 | 72 | 52,3 | 64 | 7,2 | 19,7 | 28 | 20,7 | 29 |
| " | 17 | 1,80 | 71 8 | 60 | 53 6 | 73 | 0 4 | 18,2 | 25 | 6,4* | — |
| " | 23 | 1,84 | 75,8 | 80 | 57,5 | 80 | — | 18 3 | 24 | 22 5* | — |
| " | 39 | 1,68 | 67 | 55 | 40,3 | 61 | 13,7 | 26,7 | 40 | 14,7 | 27 |
| " | 70 | 1,72 | 73 | 70 | 53,6 | 62,5 | 5 8 | 19 4 | 27 | 16 4 | 23 |
| " | 77 | 1,66 | 67 | 75 | 43,5 | 58 | 3,6 | 23,5 | 35 | 31,5 | 42 |
| " | 64 | 1,63 | 65,6 | 70 | 47,5 | 63 5 | — | 18 1 | 28 | 22,5 | 32 |
| " | 64 | 1,69* | 68,9* | ? | 42,1 | 55,5 | 5,7 | 26 8* | 39* | — | — |
| " | 47 | 1,74 | 74,2 | 64 | 52 | 65 | 4,5 | 22,2 | 30 | 12 | 19 |
| " | 85 | 1,58* | 62* | 85 | 49 5 | 58 | 11 | 12 5* | 20* | 35,5 | 42 |
| " | 69 | 1,60 | 63 5 | 68 | 41,9 | 56 | 6,6 | 21,6 | 34 | 26 1 | 39 |
| " | 71 | 1,72 | 73 | 73 | 53,6 | 68 5 | 14 | 19,4 | 27 | 19,4 | 27 |
| | 48 | 1,76 | 75 9 | 79 | 50 | 70 | 8 | 25,9 | 34 | 29 | 37 |
| " | 57 | 1,80 | 80,4 | ? | 48 3 | 66 | 2,1 | 32,1 | 40 | — | — |
| | 52 | 1,62 | 65,4 | 74 | 54 5 | 68 | 0,5 | 10,9 | 17 | 19,5 | 27 |
| " | 66 | 1,72 | 72 9 | 95 | 58,8 | 79 | 6 5 | 14,1 | 19 | 36 2 | 38 |
| | 66 | 1,82 | 83,1 | 80 | 61 | 77,5 | 24,5 | 22,1 | 27 | 19 | 24 |
| " | 37 | 1,86 | 84 6 | ? | 47,5 | 74,5 | — | 37,1 | 44 | — | — |
| " | 61 | 1,70 | 71,5 | 78 | 49,4 | 62,5 | — | 22,1 | 31 | 28,6 | 36 |
| | 52 | 1,77 | 77,1 | 65 | 53,4 | 71,5 | 10,6 | 23,7 | 31 | 11,6 | 18 |

* Behind the figure for weight means influenced by curvation of back

TABLE 16 WEIGHT OF 10 PATIENTS DIED FROM STARVATION

| | | Age | Height | Weight | Ideal weight | Difference |
|---|---|---|---|---|---|---|
| | | year | m | kg | kg | % |
| D | Male | 65 | 1,78 | 48* | 79,2 | |
| v H | " | 84 | 1,76 | 39,9* | 75 | |
| K | | 68 | 1,68 | 38 | 68,7 | — 45 |
| R | | 68 | 1,75 | 40 4 | 76 | — 47 |
| d R | | 81 | 1,68 | 85,7* | 66 | |
| S | | 79 | 1,70 | 65,2* | 69 | |
| W | | 71 | 1,72 | 40,5 | 72,5 | — 44 |
| W | | 85 | 1,80 | 36 8 | 80 | — 54 |
| H | | 81 | 1,77 | 45 8 | 75 | — 37 |
| B | Female | 40 | ± 1,65 | 28 | 65,2 | — 56 |

* behind the figures for weight means heavy oedema

The belly was sometimes swollen through meteorism Occasionally also, in cases of severe oedema, there was ascites, clapotage could easily be elicited The liver and spleen characteristically were not enlarged



I I(

FIG 30



FIG 34



FIG. 35

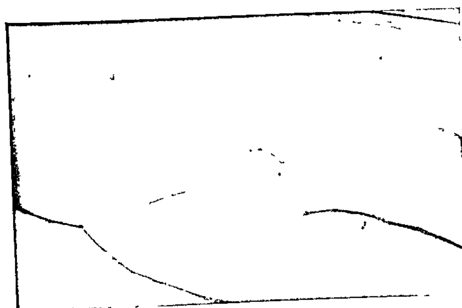


FIG 36

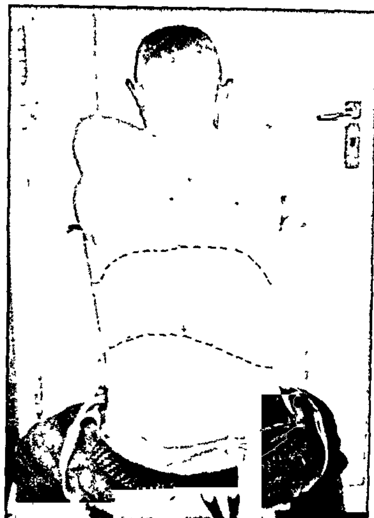


FIG 38

FIG. [illegible]

FIG. 39

standing thus pain was exacerbated Some cases were bedridden because of it The body length diminished and kyphoscoliosis developed

On X ray examination a pronounced osteoporosis was found in some cases especially the older patients with marked emaciation STOLTE reported a second form of bony abnormality, observed in middle aged and young women especially nuns, who because of their mode of life, had little exposure to sunlight These patients were not as severely emaciated as the former group The most prominent symptom was pain and X ray examination revealed decalcified zones interrupting the normal cortical pattern Such lesions had previously been described by LOOSER At the site of pseudo rupture an actual fracture could occur (see chapter VI d)

*Prognosis*

The prognosis of the starved patient was most accurately assessed on clinical grounds Severe emaciation a cold cyanotic skin, a feeble pulse and stupor were unfavourable signs Obstinate diarrhoea was also of grave significance, particularly when dehydration had not been corrected

In determining the prognosis account had to be taken of the three common modes of death 1 sudden, inexplicable death a short time after a patient s admission to hospital, 2 unexpected death of those who at first seemed on the way to recovery but who suddenly manifested a relapse with feeble pulse and fall in blood pressure death resulting in about an hour and 3 a slow death preceded by a state of coma which might last for a day or two — in fact such a death as is seen in any exhausting disease The deleterious effects of starvation could be seen reflected in the death rates (see chapter II, c) Amongst the cases admitted to hospital the mortality was about 10 %

*Autopsy findings*

At autopsy few gross abnormalities were found What was most striking, was the absence of fat from the subcutaneous tissue and from around the internal organs The weights of individual organs were sometimes lower than the average normal but this was not invariable In six autopsies where the weights of organs measured the heart weight was subnormal in only one case, namely 210 gms In one case the weight of the liver was 900 gms, in three cases 1000 gms and in the remaining 1400—1450 gms In three cases the spleen weighed 100 gms in two cases 120 gms and in one case 170 gms

In many cases bronchopneumonia was noted

Observations made from autopsy material from cases of starvation exposed to prolonged and severe cold have been published by A DE MINJER In the days preceding death, these patients had had a very low body temperature from 25° to 31° Some had no glycogen in the liver or muscles There were others, however where the liver contained abundant glycogen In one case no other cause of death was found, so that it was assumed that the metabolism had become so depressed that life could not be supported In four patients whose liver glycogen was high considerable atrophy of the thyroid gland, with few acini and considerable connective tissue infiltration was found In two cases the thyroid gland was normal but in one there was central necrosis of the liver lobules and in the other the liver showed a picture of a diffuse hepatitis Finally in one patient a severe anaemia and extensive

fatty degeneration of the parenchymal organs were found A similar fatty degeneration was not found in the other hypothermic patients

*Treatment*

For the seriously affected patients treatment consisted in the first place in giving complete rest and a supply of heat Less seriously affected patients were not kept at complete rest in bed, a certain amount of ambulation was given to promote recovery of muscle tone

As regarding feeding, extensive trials were made of protein hydrolysate The preparation used for alimentation was a mixture mainly composed of casein hydrolysate with a proportion of beef hydrolysate (about 1/5 to 1/6) The hydrolysis had been enzymic The idea behind the recommendation of giving protein hydrolysate was, that in starvation fewer alimentary ferments would be formed than with normal nutrition In practice it appeared that the hydrolysate available was comparatively disagreeable to take It was thus soon disliked and sometimes it was vomited A disadvantage of hydrolysate from a psychological point of view, was that the patients got the impression that insufficient quantities of food were being supplied There was no evidence of a detrimental influence of hydrolysate as far as producing diarrhoea, nor was an existing diarrhoea affected

Appendix Nr 27 outlines the tentative recommendations drawn up as a guide for the feeding teams as regards the use of the hydrolysates and serum available

A drawback in the original recommendations for treatment with oral hydrolysate was, that the patient had to consume too great a quantity of liquid The hydrolysate solution on the other hand had the advantage of containing only very small amounts of salt Comparative dietary trials were made with the hydrolysate glucose solution in various concentrations and with diets containing 80 to 300 gms of whole protein and supplying 2000 to 3200 calories It was concluded that the hydrolysate in low concentrations had little or no favourable effect in dispersing oedema, adynamia and apathy Two litres per day of hydrolysate in a concentration of 7,5 to 10 % with an equal quantity of glucose had a moderately good effect

A diet of 300 gms of whole protein supplying 3200 calories, however, gave much better results

The patients who had been on the last mentioned regimen, were observed often to have recovered from their depressed and apathetic state within two days, the oedema and adynamia had disappeared and they could be mobilized more quickly than those given the hydrolysate when the oedema had disappeared they showed increase in body weight

In a number of cases who owing to dehydration or to a depression of consciousness, had difficulty in swallowing and in those who refused food because of psychosis, feeding by tube was carried out (fig 39) In this way two litres of hydrolysate in a concentration of 5 to 7 5 % with glucose was given daily In those who refused food the results were good but a diet containing 200 gms of whole protein per day was equally satisfactory As soon as possible tube feeding was replaced by oral feeding Usually this was practicable in one or two days With desiccated patients in a state of circulatory collapse there was no improvement with the tube feeding either with hydrolysate or other food

The acid hydrolysate supplied for intravenous administration was unsatisfactory

in that it led to the formation of thrombosis of the veins. Its use was thus soon discontinued.

Through experience the following scheme was worked out.

1. Patients who could not swallow were fed by tube with a mixture of hydrolysate and glucose in 7,5 % concentration or with a concentrated liquid food, rich in protein and calories but poor in fat (milk, skimmed milk powder and glucose). Such food could supply 2500 calories a day.

2. Patients who could take food in the ordinary way were given a diet containing at least 2500 calories and at least 80—100 gms of protein. A diet rich in protein and carbohydrate and *in which the protein* was obtained chiefly from skimmed milk powder was given according to the scheme below.

7 o'clock: oatmeal or ricemeal porridge, full cream milk mixed with three *heaped* tablespoonsful of skimmed *milk* powder and one tablespoonful of glucose, three slices of bread with jam, meat, cheese or butter.

10.30 o'clock: "protein food", i. e. three tablespoonsful of skimmed milkpowder and one tablespoon of glucose, with raw or preserved fruit as flavouring (served cold).

12 o'clock: meat, potatoes, minced vegetables and "protein food".

15 o'clock: protein food.

18 o'clock: as at the 7 o'clock meal.

The patients were urged to eat as much as possible. Those whose intake amounted to about 80 gms of protein and 2000 calories gained little in weight though their oedema disappeared. Such patients could be made to gain weight and to improve in general condition by giving a supplement of 100 gms of butter a day. This suited them excellently. Complications were treated as follows:

*Diarrhoea* was treated with kaolin 60 gms per day, opium in moderately large doses and sulfa drugs such as sulphathiazole, sulphapyridine, sulphamethylpyridine and sulphaguanidine. In most cases a change in diet did not appear to be necessary. In a few obstinate cases a diet low in cellulose was required.

*Shock* or circulatory failure was treated with transfusions of plasma, often intrasternally, but in general the results were not encouraging.

*Heart failure* was treated with digitalis *and salyrgan. (Uncomplicated* hunger oedema did not respond to these medicaments. In one case only did oedema disappear as a result of injections of vitamin $B_1$, in all other cases these injections had no effect on the oedema. A number of *cases were observed in* which the blood pressure remained low for a long time but was raised as a result of injections of ambinon and cortine.)

*Psychosis* more or less pronounced and associated with some delirium was noted as due to starvation. In these cases administration of an adequate quantity of food, if necessary by forced feeding, was quickly followed by *improvement*. Hypoglycaemia may have been the cause.

*Anaemia* was not influenced by the administration of vitamins, injections of liver extract or ferrous preparations either with or without hydrochloric *acid*. In severe cases of anaemia blood transfusion was necessary. In the other cases with adequate feeding a gradual but slow improvement occured.

When the haemoglobin rise lagged behind that of the red cells, iron *rectified this*

*Dermal haemorrhages* were not improved by the administration of vitamin C. They gradually disappeared under general treatment.

*Pigmentations* were also uninfluenced by vitamin C. In some cases there was a suggestive improvement after giving nicotinamide.

*Glossitis*, the painful red spots on the tongue, also seemed to be favourably influenced by injections of nicotinamide.

*Bone dystrophies*, both the general osteoporosis associated with severe emaciation and kyphoscoliosis and the localised osteodystrophy with LOOSER zones, reacted well to injections of vitamin D 3. The results were more rapid in the latter type of case. With adequate feeding and vitamin D injections callus was observed to form at the side of the lesions.

*Hypothermia* and its treatment has been considered by A. DE MINJER. It was shown experimentally that when owing to marked cooling of the body, the heat regulating mechanism collapsed, a rapid warming in a bath at 40 is more effective than a gradual warming. The administration of [illegible] was advised and in addition that of adrenaline and thyroxin to promote the mobilisation of the glycogen still present in the liver. JONGBLOED also on physiological grounds has made recommendations. He considered it more rational to [illegible] heat by wrapping the patient in a warm bed rather than to supply heat from the outside of the body. He advised infusions of glucose and the inhalation of oxygen with [illegible] carbon dioxide to promote heat production within the body.

### *The condition of the infants and young children*

The food supplies available for infants and young children are discussed elsewhere (see chapter II a). Figures however do not give the complete picture. The milk supply was variable and in the later stages before liberation pasteurization was impossible and deliveries delayed up to six days. While the cow's milk was frequently of poor quality, maternal milk analysis also gave variable results. Often the fat content had declined to less than 1 [illegible] but better and not infrequently normal figures were obtained. As rice meal was not available special children's meal and later substitutes containing considerable cellulose were issued. Glucose and nutromalt were scarce. Treacle made from sugar beet liquor was supplied.

By and large during the starvation period the condition of the infants was good as their food was just sufficient. Only in those instances where the parents were asocial and sold the coupons of the infants were starved infants found. With the infants the greatest difficulty was caused through lack of heating, clothing and soap.

### *Clinical state of children*

Almost all children lost in weight, though at first they still grew in length. This growth also ceased in the months before the liberation. Very often there was a remarkable swelling of the abdomen by meteorismus (fig. 40).

Owing to dirt and the frequent occurrence of scabies and pediculosis the skin was often the seat of infection resulting in pyoderma. In children suffering from lack of vitamin A, hyperkeratosis was seen around the hair follicles, defects of epithelisation were also seen after skin damage. No keratomalacia was seen. In spite

of a lack of vitamin C, scurvy hardly ever occured JONXIS only saw two cases SOETERS none

Hunger oedema was also comparatively rare In 2 cases observed by JONXIS the albumin and globulin levels in the blood, as determined by the KJELDAHL method, were normal

In the nervous system no clinical signs suggesting a deficiency of vitamin B were noted The mental development of the children continued good for a long time Only the younger ones declined in this way In the last few months, however, before the liberation even the older ones became more indolent and troublesome, but that degree of indolence observed with adult patients did not occur

Owing to the fact that many fathers of families had been arrested and the mothers were obliged to spend much time on tours to secure food, the family life was broken up The older children left to themselves showed signs of running wild pilfering, stealing and carrying on a black market

The body temperature of the underfed infants was remarkably low in the winter months, temperatures below 30° were often recorded

Many children suffered from diarrhoea, which ran the course of bacillary dysentery Bacteriological examination of the stools usually gave negative results Pathogens when isolated, especially at the beginning of the illness, were of the type Sonne or New Castle In many infants these intestinal infections were the direct cause of death, and this applied particularly after the liberation

JONXIS observed many pulmonary affections, roentgenograms showed infiltrations especially around the hilus and in the inferior lobe

In the latter months many children complained of pain in the legs This pain seemed to be localized in the bones, which on pressure were very painful Many infants had great difficulty in standing or walking and adopted a very remarkable lying attitude with the knees drawn up high Roentgenograms showed an osteoporosis Blood examinations on the malnourished children yielded the following results

Vitamin C low, often between 0,1 and 0,2 mg per 100 ml, in the last month before the liberation the carotene average level was 4,2 gamma per 10 ml (highest level 12 gamma, lowest level 3 gamma) vitamin A average level 1,9 I U per 10 ml many children had no vitamin A in the blood (fig 41) Children upwards of 10 years of age with normal values were seldom observed as was the case with adults) serum calcium was low, average 8 mg %, serum globulin was mostly a little high, albumin low

Most children suffered from a moderate anaemia

*Mortality*

The mortality amongst infants and children was high (see Supplement chapter IX) This increased death rate was not exclusively caused by starvation but was also due to bad hygienic conditions and to diphtheria and dysentery Even well fed children died of dysentery or of an intestinal disease resembling dysentery Shortage of hospital beds was a contributory factor

*The change at the liberation*

Immediately after the liberation feeding teams arrived from the South For infants and older children they had supplies of milkpowder, glucose and flour

The greatest demand was rice meal and glucose which was distributed on a large scale In Rotterdam 1200 nipples were issued in a short time Fresh milk even in the large towns became available more readily This was in part due to the increased milk production (season spring) In the beginning the greatest problem was the transport of the milk Sugar was scarce but the feeding teams disposed of large quantities of glucose They could not however meet the demand for textiles

*The treatment of the underfed children*

Most of the starved children could immediately take normal food Only in very severe cases was a special diet necessary In such cases protein milk was an effective aliment Children showing signs of collapse were sometimes treated with blood or plasma transfusions and with hypodermoclyses Some were supplied with maternal milk obtained locally or from the three southern provinces Some children received in addition 100 to 250 ml of protein hydrolysate in 2 5 to 4 % concentration with 5 to 7 5 % vitaminised glucose This was well taken and well tolerated, but the results were no better than those obtained with other treatments Intravenous feeding with a locally produced hydrolysate of different composition known as capaine yielded good results in some cases

In cases of hunger oedema bedrest and salt free diet were sufficient to cure the oedema Administration of vitamin $B_1$ was without effect The pain in the bones disappeared as soon as the rations improved Large dosis of vitamin D e g 300 000 I U also relieved the pain

Anaemia was cured with the administration of iron Diarrhoea was treated successfully by supplying protein milk True dysentery could be controlled with sulphaguanidine, but in the diarrhoea and vomiting of infants these means were unsuccessfull Unfortunately it was *only available in limited quantities*

The lesions caused by lack of vitamin A (underweight infections of the lungs defective epitheliasation of wounds and hyperkeratosis) disappeared quickly after the administration of vitamin A this was noted in a group of children who in April could be supplied with 17 000 I U of this vitamin per day Another group of children were supplied with a corresponding amount of carotene dissolved in rape oil Although the carotene values of their blood rose considerably there was scarcely any effect on the vitamin A levels which rose only from 0 1 to 0 8 All symptoms of vitamin A deficiency remained the same It seemed that carotene was not converted to vitamin A A few weeks after the liberation a similar examination was made with two groups of children who had a low level of vitamin A in their blood One group received carotene in rape seed oil the other vitamin A (17 000 I U) The children received sufficient food of a good quality though the total quantity of fat was small and the food did not contain any other important vitamin or carotene sources Within a week the children who had received the vitamin A showed the results of the treatment The signs of vitamin A shortage disappeared and the vitamin A values became normal The carotene group also showed improvement but not so rapidly The level of carotene in the blood became very high and after two weeks the average level of vitamin A had risen to 2 5 I U Probably the difference in the results of administration of carotene before and after the liberation was caused by an unknown factor which was present only in the food supplied after the liberation It seems that for children at least this factor is necessary for the

conversion of carotene into vitamin A and probably this factor is present in various fats and oils

D PATHO PHYSIOLOGICAL ASPECT OF STARVATION

*Psyche*

The apathy and irritability were widely noted Disturbances of sleep rhythm and depression were commonplace The forgetfulness, lack of concentration, emotional instability and failure of understanding were in the elderly no doubt in part due to senile arteriosclerosis, but they also occured, though to a less extent in younger people In exaggerated forms these symptoms amounted to an acute psychosis often with violence, refusal of food, persecution mania, marked disorientation and moral turpitude, resembling KORSAKOW's syndrome

The markedly rapid improvement which followed feeding, if necessary forced feeding, indicated that starvation was the main cause, even in the elderly Other factors such as fear, worry, cold and physical exertion may have played a part in the causation

Some of the symptoms may have been due to hypoglycaemia In the severest cases intravenous injections of glucose caused tempory improvement, but relapse usually occured Low values for fasting blood sugar were the rule and undoubtedly some symptoms were due to this, as they were relieved by food

*Nervous system*

Three types of neurological syndrome suggestive of being due to starvation were reported

1 Several elderly patients had cerebral lesions (e g facial paresis, motor aphasia and hemiparesis and hemianopia) which improved symptomatically very rapidly after food treatment Possibly an improvement in circulation was responsible

2 Neuritic syndromes (peroneal nerve paralysis, neuralgia paraesthetica poly neuritis, herpes zoster and retrobulbar neuritis) were reported often in association with oedema There was, however, no dramatic improvement with thiamin medication but gradual improvement with general feeding General undernutrition or toxins may have been responsible

3 Paraesthesiae without objective physical signs were most common Causalgia was rare These patients could bear no form of pressure on the affected extremities and damp cooling was very soothing Although a relationship to pellagra or aribo flavinosis has been suggested, there were in such patients no skin lesions of pellagra Nicotinic acid amide did not relieve the symptoms which were slow to disappear Some still complained of them in a follow up three months later

*Neuro muscular system*

The weakness of the muscles was sometimes so great that successive movements were impossible Trembling and a feeling of stiffness associated with slow muscular contraction, accompanied the weakness Cramps and spontaneous ' muscle jumps ' occured frequently particularly in bed Muscles showed fibrillation and were often very tender The reflexes were usually brisk but CHOVSTEK s sign was almost always



FIG 43

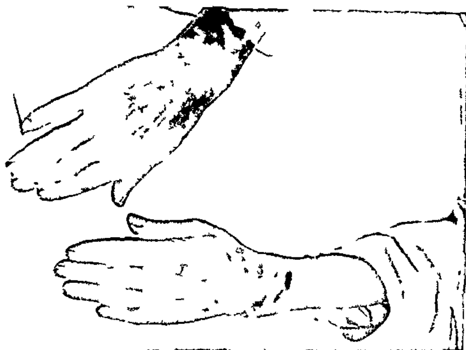


FIG 45

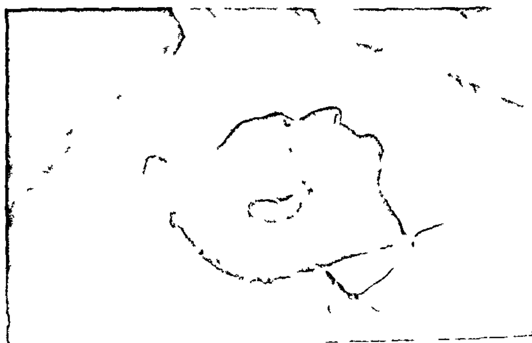


FIG 46

negative The idio-muscular contraction of SCHIFF was almost universally present (fig 42)

Histological examinations (POMPE) showed atrophy, cloudy swelling and sometimes ZENKER's degeneration The muscles themselves were therefore abnormal, but neuro muscular disturbances may have been in part responsible for the symptoms The blood calcium was low in some patients but the cramps and increased muscular irritability was seen in those with normal blood calcium levels and calcium gluconate intravenously did not relieve these symptoms

After feeding muscle tenderness, muscle jumps and cramps disappeared quickly Increased reflexes and the idio muscular contractions of SCHIFF were of longer duration

These idio-muscular contractions of the biceps brachii were still present after blocking the brachial plexus and stellate ganglion with procaine although the muscle was completely paralysed as regards voluntary movement On injecting the muscle and perimysium with procaine paralysis and hypotonia of the muscle was produced but the Schiff phenomenon was then abolished The paralysis and hypotonia began to pass off after two hours but the Schiff phenomenon could not be elicited before eight hours The phenomenon thus seemed to be of muscular or neuro muscular origin It was not abolished by tiring the muscle with voluntary contractions It could, however be exhausted by repeated applications locally of the mechanical stimulus evoking it In the cold the phenomenon was more marked and longer lasting As it seemed to bear some resemblance to the state of the muscles in myotonia congenita the effect on it of quinine was tried It was without effect even in repeated doses

*Skeletal system*

Many patients complained of rheumatism The pain seemed to be localised in the bones and not in the joints It occured especially in the fork the back, the middle of the foot and the side The pain was most marked when the inserted muscles contracted, when the bones were subjected to strain and on local pressure In all movements the patient tried to spare the affected bone In doing this the muscles were often used as a kind of splint

There were two forms of the affection The first which was not so specific, looked very much like senile osteoporosis a general lack of calcium in the bone with pronounced shortening of the body lenght through compression of the vertebrae This form occured in men and women alike and especially in old people Occasionally this general osteoroposis was seen in younger folk who complained mainly of their backs The second form was more characteristic On skiagrams of the skeleton one usually saw only slight osteoporosis or none at all In one or more places however, the corticalis was interrupted by a broad or narrow stripe of non calcified tissue (osteoid?) zone of LOOSER These zones were principally found in the branches of the pubic bone, the neck of the femur the metatarsal bones, the ribs etc (fig 43 and 44) They *healed by the formation* of callus but otherwise did not behave as fractures Sometimes both forms of the affection of the skeleton occured in the same case The second form was seen principally in slightly emaciated women, whereas the first was seen in men and women, who were grossly underweighted and who often had diarrhoea

Both forms were described as "hunger osteopathy" after the first world war Their aetiology is still not quite clear The rontgenological appearances of the first form, however, are so like those of rickets and osteomalacia, that they suggest a deficiency Shortage of vitamin D and of minerals of the bones must be considered For adults and especially for old people, who for one reason or another did not fall into the category of those, who received an extra supply of milk etc , the supply of vitamin D had undoubtedly been insufficient for more than three years This must have affected those seldom exposed to sunlight e g nuns, invalids and old people VAN OVEN drew attention to these symptoms in 1943 It is easily understood, why in the hunger-winter of 1944/45 the frequency increased Up to October 1944 the diet contained a fair amount of calcium, but after that it decreased rapidly The phosphate and the Ca/P ratio were adequate Much calcium must have been lost through diarrhoea, especially if the stools were fatty Moreover, MC GANCE et al in 1942 showed that the protein in the foods is of great importance for the absorption of calcium (and magnesium) from the gut The shortage of vitamin D was, however, the most important aetiological factor. Hence "hunger osteopathy" comes into line with osteomalacia The rapid recovery after the administration of vitamin D confirms this Also, children who received vitamin D did not suffer from it nor from rickets The chemical data (see table 17) also confirm this hypothesis On 14 patients with

TABLE 17 BIOCHEMICAL DATA IN HUNGER OSTEOPATHY

| Age | | Osteoporose | Looser zônes | Loss of weight | Oedema | Calcium | Anorganic phosphate | Phosphatase | Total protein | Albumin | Phosphate | Calcium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Female | 49 | — | + | ± | — | 8,7 | 3,10 | 10,8 | 6 9 | 4 2 | 0,563 | 107 |
| , | 56 | + | + | ± | + | 9,1 | 3 25 | 9,9 | 6 4 | 3,9 | 0,390 | 112 |
| Male | 39 | ++ | — | +++ | +++ | 7,4 | 2,15 | 9,2 | 3,2 | 1,8 | 0,271 | 70 |
| " | 62 | ++ | — | ++ | +++ | 8,1 | 6,30 | 4 6 | | 3,2 | 0,755 | 23 |
| , | 30 | + | + ? | +++ | — | | 2,50 | 10,8 | 3 6 | 2,2 | 0,217 | 72 |
| | 63 | ++ | — | ++ | ++ | 10,4 | 4,70 | 4,2 | 4,9 | 2,9 | 0,677 | 105 |
| , | 67 | ++ | — | +++ | +++ | | 3 85 | 7,6 | 4,6 | 2,7 | 0,143 | 51 |
| , | 77 | +++ | — | ++ | — | 6,2 | 4 15 | 7,6 | 5,8 | 3,0 | 0,172 | 44 |
| \ | 69 | ++ | — | ++ | ++ | 7,2 | 2,10 | 4,0 | 4,5 | | 0,269 | 161 |
| , | 66 | +++ | — | +++ | +++ | 8,7 | 1,40 | 10,4 | 5,9 | 2,9 | 0,079 | 120 |
| | 70 | ++ | — | ++ | ++ | 8,4 | 3,25 | 5,6 | 5,9 | 3,2 | 0,564 | 80 |
| | 76 | ++ | — | ++ | + | 9,0 | 3,90 | 10,4 | 5,6 | 3,2 | 0,895 | 117 |
| " | 71 | +++ | ± | ++ | +++ | 5,7 | 1,95 | 8,0 | 5,3 | 3,2 | 0,216 | 100 |
| | 55 | + | — | + | + | 8,2 | 3,15 | 10,2 | 5 2 | 2 9 | 0,746 | 63 |
| average | | | | | | 8,1 | 3 27 | 8 1 | 6 0 | 3 0 | 0,425 | 87,5 |

"hunger osteopathy" (2 with LOOSER zones, 2 with suggestions thereoff and 10 with general osteoporosis) blood and urine examinations were made The blood calcium appeared to be on the low side, the phosphate content varied greatly, the phosphatase content was on the high side, the albumin had clearly decreased Only a small but variable quantity of phosphate and but little calcium were excreted in the urine in 24 hours These are also the chemical findings in osteomalacia

Hunger osteopathy considered as a shortage of vitamin D requires further discussion The influence of other deficiences, e g of protein, is not clear From

some observations one would judge, that there is little relation although hypalbuminaemia was almost always present in the patients with hunger osteopathy Thus in two markedly emaciated women no hunger osteopathy and a normal excretion of calcium in the urine were found, whilst the two women with hunger osteopathy, mentioned in the table, were not greatly emaciated The first two women had been taking cod liver oil under the pretext of tuberculosis (the other extras they gave to their children) There was no relation between either the degree of emaciation or the serum albumin and the osteoporosis

Probably the form with the zones of LOOSER was mainly caused by the shortage of vitamin D whilst the general osteoporosis could be ascribed to this, with an insufficient supply of calcium Serious or persistent diarrhoea was not a symptom of the patients with zones of LOOSER but was in the cases of osteoporosis Hence it is easily understood, why in the sunny tropics osteoporosis has been recorded but not the type with Looser zones Whilst the fissures healed rapidly with vitamin D only, *intravenous injections of calcium to cases of generalised osteoporosis* certainly produced a more rapid improvement

The localisation of the fissures was clearly determined by mechanical factors (STEENHUIS and KOOLEMAN POMPEN et al ) The similarity with fatique fractures is really remarkable The inferior skeleton appears to react to normal use in the same way *as the normal skeleton to excessive use e g march fracture There was* no doubt, that the form with the zones of LOOSER occured much more frequently among women than men One observer saw 9 clear cases in women and 2 far less certain in men The same thing was noted in France Whilst serious emaciation was seen less among women than men in general shortage of sunlight was more *common among women Many of the patients with zones of LOOSER were nuns* who on account of their mode of living and their clothing get very little sunlight

The process of healing during treatment was also interesting That vitamin D was the principal factor concerned appeared from the fact that signs of healing were delayed for a long time so long as there was only improvement in the food *Better results were seen from injections of vitamin D 3 than from vitamin D orally*, contrary to POMPEN et al who noted no difference Two to three days after the injection (600 000 I U ) a manifest change occurred The dejected patient was cheerfull and complained of less pain there was considerable improvement in the tone of the muscles After two or three weeks there was little pain on movement and the X ray picture showed the beginning of callus formation, which increased in density until the 8th week In the osteoporotic form much more calcium was needed for the restoration of the skeleton so that it is not surprising, that three months after the beginning of the treatment the osteoporosis had not completely disappeared

### *Cardiovacular system Kidneys*

### *(Hunger oedema)*

Symptoms referable to cardiovascular insufficiency as a whole were rare Dyspnoea palpitations and dizziness and syncope occurred, but may in part at least have been due to anaemia

The heart on physical examination appeared normal Cardioscopy often revealed a diminished heart shadow Bradycardia and a tendency to hypotension were the

stronger evidence against the hypalbuminaemic character of the oedema The values of protein content of the oedema fluid found by BOK and others were higher than those found in true hypalbuminaemic oedema

It is worth considering whether the relative high fluid intake during the occupation had any influence on the development of oedema At present the supply of fluid is generally considered of minor importance in the different kinds of oedema SCHLEMM even considers water as a diuretic in cardiac oedema In the aforementioned tests of KOHMAN, the hunger-oedema developed more readily, when a diet containing liquid was given, than with a dry diet In the present instance the fluid intake seemed of little importance Oedema often disappeared quickly not withstanding a supply of 3 litres of water per day. One even got the impression that strict limitation of liquid was ill supported, probably due to the co existance of oedema and dehydration

In the tests of KOHMAN salt had little influence on the development of the oedema Yet it is clear that for the retention of every litre of water, several grams of salt are needed FIESSINGER, GOUNELLE, VALLERY-RADOT are of the opinion that in French patients with hunger oedema during the latter years, there was a relation between the salt content of the food and the oedema In the Netherlands no connexion between the usually normal chloride content of the plasma and the oedema could be obtained Loss of oedema was accompanied by a considerable excretion of salt, especially if one considers, that in both groups the diet was poor in salt The effect of an extra dose of 10 grams of salt was tried One patient (B) was in bed, the other (H) was mobilized (see table 18) During the test both received

TABLE 18 INFLUENCE OF THE INTAKE OF 10 G OF SALT IN TWO PATIENTS, SUFFERING FROM HUNGER AND LOSING THEIR OEDEMA

| | | 12/6 | 13/6 | 14/6 | 15/6 | 16/6 | 17/6 | 18/6 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 10 gr salt | |
| Pat B (in bed) | albumin | 2 8 | 2,8 | | | 3,0 | | 3,5 | gr p 100 ml |
| | plasma NaCl | 580 | 581 | | | | | 576 | mgr % |
| | cc urine | 1850 | 1700 | 1750 | 1900 | | 1300 | 1800 | 1500 ml |
| | urine NaCl | 9,1 | 11,1 | 12,7 | 6,4 | | 13,1 | 13,1 | 8,5 gr |
| | oedema | | | | | | — | — | — |
| | weight | 41,9 | 42,2 | 42,6 | 42,5 | | 42,9 | 44,0 | 43,6 kg |
| Pat. H (mobilised) | albumin | 3 6 | 3 3 | | | 3,3 | | 4,0 | g % |
| | plasma NaCl | 560 | 563 | | | | | 609 | mg % |
| | cc urine | 1900 | 1200 | 1000 | 1500 | | 1730 | 2400 | 1500 ml |
| | urine NaCl | 4,8 | 8,4 | 6,5 | 10,9 | | 10,3 | 10,5 | gr |
| | oedema | — | — | — | — | | + | + | — |
| | weight | 49,5 | 50 | 50,9 | 50,8 | | 52,2 | 52 9 | 52 6 kg |

a diet poor in salt but they could drink water ad libitum The weight was determined every evening at the same time On 17/6 both received 10 g of NaCl in water at [illegible] developed [illegible] tention of [illegible] o have any great tendency to retain salt [1])

[1]) FORMIJNE et al were unable to produce oedema in a patient whose oedema had disappeared even when 20 g of salt were given daily for 5 days

Patients with uncomplicated hunger oedema had no cardiac failure. The venous pressure was on the low side. Hence a general venous back pressure was not responsible for the oedema. Digitalis had no diuretic effect and salyrgan but a transitory one. Yet it is not improbably that the venous flow was defective, especially from the extremities due to a loss of fat and muscle. The loss of the propulsive force of muscle contractions and the loss of turgor of the tissues would diminish the venous return.

The cause of the oedema could not have been due to renal damage. In the uncomplicated cases (many cases of nephritis were sent to hospital with the diagnosis of hunger oedema) neither albumin nor sediment was found in the urine. The ability of the kidneys to secrete urine of low and high specific gravity was normal. Salt was also secreted without difficulty; this is seen from the blood and urine chemistry. While there were some observations that suggested a slight impairment of the VAN SLYKE urea clearance test on a patient's admission to hospital, by the time of his discharge normal figures were obtained (an average in 14 determinations of 84 % normal).

All the evidence points to an abnormal permeability of the capillaries as the cause of the oedema. Although the capillary function which is tested in the RUMPELL LEEDE test differs from that controlling the permeability to liquids and oedematous cases. The few patients who gave negative results had no oedema. More important still was the fact that local and general infections favoured the formation of oedema. In some patients the oedema was limited to one arm or one leg; these cases had local lesions, e. g. furuncles or ulcers. Moreover oedema sometimes developed rapidly following the onset of an infectious disease. For instance a boy of 16 was admitted to hospital with general oedema. No other cause than underfeeding could be found. Benign tertian plasmodia were found in his blood. The mother said that the boy had had cold shivers the day before. One hour later the oedema appeared.

Summing up, one may draw the following conclusions: the primary cause of the hunger oedema is shortage of protein in the food; in the long run this damages all the cells of the body, particularly the capillary endothelium which becomes abnormally permeable; atrophy of the muscles and loss of turgor of the tissues favours the development of the oedema; hypalbuminae also favours the oedema by reducing the water binding power of the blood; and a high salt content of the food facilitates the retention of the oedema. Why some persons had a firm oedema is unexplained. Gravity has a great influence on the distribution of the oedema. Whether alterations of the pH of the blood had any influence on the oedema was not sufficiently investigated, but the precipitating factors of muscular exertion, inflammations and infections suggest such a possibility.

*Blood*

It is seen from the data in chapter VI c 2 that the majority of the patients had anaemia. In uncomplicated cases this was a slightly hyperchromic to normochromic, slightly macrocytic anaemia. Its degree closely reflected the seriousness of the malnutrition.

The anaemia was not haemolytic: the bilirubin content of the blood was low, the urine contained little or no urobilin, the number of the reticulocytes was low, the osmotic fragility of the red cells was not increased, and there was no question

stronger evidence against the hypalbuminaemic character of the oedema The values of protein content of the oedema fluid found by Bok and others were higher than

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mentioned tests of Kohman, the hunger oedema developed more readily, when a *diet containing liquid was given, than with a dry diet* In the present instance the fluid intake seemed of little importance Oedema often disappeared quickly notwithstanding a supply of 3 litres of water per day One even got the impression that strict limitation of liquid was ill supported, probably due to the co existance of oedema and dehydration

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The anaemia was not haemolytic, the bilirubin content of the blood was low, the urine contained little or no urobilin, the number of the reticulocytes was low, the osmotic fragility of the red cells was not increased, and there was no question

of increased haemopoiesis in the bone marrow Neither was it a question of lack of iron As already mentioned, the amount of iron in the food was fairly satisfactory up to the time of the famine proper The frequent hypo and a chlorhydria and the diarrhoea did not favour the absorption of iron The normal reserve, however, is fairly large The values of iron in the serum determined by BOK and HULST were somewhat contradictory HULST found normal values BOK (in cases with severe anaemia) low values Treatment with iron preparations and hydrochloric acid did not cause any acceleration of the rise of haemoglobin, except in the hypochromic phase mentioned below Nor was there any parallel with pernicious anaemia nor with the anaemia of LUCY WILLS There was no megaloblastosis in the blood or bone marrow, the achylia was not obligatory, the haematological findings differed, there was no hyperbilirubinaemia nor urobilinuria, treatment with liver preparations and yeast were without effect This last makes it improbable that there was a deficiency of folic acid

Everything points to an "aplastic" type of anaemia The haematological picture, the diminished activity of the bone marrow and the low "endogenous" excretion of uric acid would support this Here too the cause was probably the shortage of protein in the diet With better diets an improvement set in, in parallel with the progress of the general condition Occasionally the increase of haemoglobine lagged behind that of the red cells In this hypochromic phase the administration of iron had a manifest effect There may thus have been a latent iron deficiency The rather low average of mean corpuscular haemoglobin concentration had already indicated this

*Endocrine system*

The endocrine system was but little involved during the starvation The lowered basal metabolism was not due to thyroid insufficiency, the cholesterol content of the blood was not materially increased the heart was not enlarged, the velocity of the circulation was only slightly retarded Adrenal cortical impairment was absent, as shown by the normal blood Na en K figures, in spite of the adynamia, the apathy, the tendency to hypotension and to pigmentation Moreover the speedy recovery with good feeding is against this Gynaecomastia and mastodynia occurred frequently in men and boys As at post mortem POMPE found adrenal glands remarkably robust in relation to the cachexia, with broad cortices, one might consider an abnormal production of oestrin and of the 11-dehydro 17-hydroxycorticosterone which according to ALLBRIGHT, is related to the conversion of protein to glucose The similarity of the skin signs of the hunger disease to those of CUSHING's syndrome (thin, transparent skin with superficial haemorrhages) was notable

Judging from the tendency to hypoglycaemia, the islands of Langerhans were perhaps overactive due rather to the fact that the food was poor in fat and calories and relatively rich in carbohydrates during the whole time of the occupation, than to the underfeeding itself The favourable effect on the obese diabetic was noted very early

The tendency to lowered blood and urine calcium and the increased irritability of the muscles suggested hypofunction of the parathyroids CHVOSTEK's sign was, however, mostly negative Between April 1944 and May 1945 several cases of spontaneous tetany were seen, a disease up till then extremely rare in the Netherlands Slit lamp examinations of a number of cases by v D VALK revealed several cases

with subcapsular densities. Usually the blood calcium returned rapidly to normal though the irritability of the muscles lasted much longer. One may postulate with FROHLICH, that the low blood calcium led to parathyroid overactivity and hypertrophy. This overactivity in some cases led to exhaustion and possible atrophy.

The gonads were undoubtedly checked in both sexes. Amenorrhoea was frequent and while this may have been in part psychogenic HOLMER found in a number of men oligospermia and in some women an inadequate production of folliculin according to findings after microcurretage. Diminished libido was complained of by both men and women. In adolescents retardation of puberty frequently occurred.

The production of maternal milk appeared to be more or less normal. The progressive cachexia with hypotension, tendency to hypoglycaemia, amenorrhoea, falling of the hair, low basal metabolism and early aging, suggested SIMMONDS' disease. On post mortem examination, however, the hypophysis was macroscopically at least normal. Moreover the majority of these symptoms soon disappeared when a diet rich in protein and calories was given.

*Alimentary system, liver*

In most cases the appetite was good. When the occasion arose, enormous quantities of food were taken at one sitting. This may have been why acute dilatation of the stomach was so often observed. The remarkable frequency of volvulus, especially of the sigmoid, was probably due to the excessive roughage in the food. The severest cases often had difficulty in swallowing. This was caused from dryness of the mouth and tongue (diminished secretion of saliva), weakness of the muscles and especially from aphthous ulcers of the mouth and pharynx. Whether these aphthae were due to a specific deficiency is unknown. Sometimes, especially in cases with diarrhoea, the tongue was fiery red and rather smooth, with or without painful fissures. The mucous membrane of the mouth and the lips had sometimes a somewhat swollen glassy appearance. Very occasionally there was "perleche". The abnormalities were probably due to a deficiency of nicotinic acid; following injections of nicotinic acid amide they disappeared rapidly.

As already noted the gastric juice was mostly of low acidity. The frequency of achylia was greater than one might expect even when the high age of most of the patients is considered. Peptic activity was usually present. The tryptic and diastatic activity of the duodenal juice was normal and also the secretion of bile.

An early and extremely frequent but hitherto unexplained symptom was diarrhoea. Hardly anyone escaped. The same holds good for flatulency. Borborygmi frequently were noted and many had an "embonpoint" from the meteorism and flabbiness of the abdominal muscles. Whilst meteorism and borborygmi were early symptoms, diarrhoea only occurred later. Usually a pappy, offensive stool was passed, occasionally it was watery or frothy. Sometimes was mucus but seldom blood. The aetiology of this diarrhoea is complicated and certainly not the same for all cases. A deficiency, e. g. of the vitamin B complex, was postulated. As noted

he diet and thiamin

is undoubtedly some

the diarrhoea. The

same held for riboflavine. At post mortem examination oedema of the wall of the intestine, especially the small intestine, was often seen. Undoubtedly the increased amount of roughage in the food was in part responsible. Moreover many serious

8

dietetic mistakes were made and the strangest kinds of food were eaten, even decomposing food Although only seldom were pathogenic bacteria found in the stools (Sonne, Newcastle and paratyphoid bacilli were recorded), nevertheless probably in many cases an infection was the cause The epidemic character was often very clear, there was often fever, and even the relatively well fed suffered Rectoscopically signs of a true colitis were sometimes found Because of the achylia much of the diarrhoea may have been due to the loss of the normal bacteriocidal action of the gastric juice

The tendency to hyperglobulinaemia with the fall in A/G ratio, the low $HgCl_2$ titre andth e abnormal galactose tolerance, all suggest an affection of the liver In a number of patients, in whom liver puncture was performed, POMPF could find pathological changes in the parenchyma (17 out of 22 cases), such as small focal necrosis, hydropic swelling and cell and nuclear anomalies It is worth noting, that during the last year before liberation, the frequency of icterus catarrhalis prolongatus and of subacute atrophy of the liver had considerably increased The work of FORSTER, WHIPPLE et al, MESSINGER and HAWKINS, ELMAN and HEIFETZ showed that insufficient supply of protein damages the liver and diminishes the resistance of the organ to infection and intoxication Especially important are the deficiencies of cystine and methionine (BEST and BIDOUT, DU VIGNEAUD, HIMSWORTH and GLYNN) These amino acids were present only in very small quantity in the low protein diet, on the other hand considerable quantities must have been mobilised by the tissue protein breakdown

*Skin*

Besides the oedema and the dehydration, the skin showed many other abnormalities Marked and rapidly developing oedema sometimes caused cracks in the dermis which showed as fine red or white lines All the patients showed a tendency to pigmentation Often a "cachetic' chloasma was seen The linea alba was often brownish All sorts of skin infections left pigmentation on healing Pigmentation of the buccal mucosa was not seen, and, as been noted, there was no question of adrenal insufficiency nor pellagra Probably once again a protein deficiency was the cause Comparison with cloasma uterinum is suggested Vitiligo occurred with some frequency The contrast with the pigmented areas was marked In the follow up three months later diminution of the pigment of these cases was noted Many patients had a fairly broad pigmented band running over the nails, parallel to the upper rim of the nail bed The cause of this was obscure

Some additional discussion on the individual deficiencies can be attempted

*Deficiency of calories*

As a result of this, emaciation was extreme MC SWINEY, the mayor of Cork, who died after refusing food for 75 days had lost 40 % of his body weight Apparently a lower level can be reached by chronic underfeeding

A direct effect of the emaciation was the frequent occurrence of prolapse, DIETL's crises, strangulated herniae, prolapsus ani and vaginae were unduly common

Sufferers from hypertension improved symptomatically during the period of food restriction Eclampsia was rarely seen (SINDRAM)

Cases of arthritis deformans and obesity also benefited at first from the loss of weight. The diminution of frequency of post operative thrombosis and embolism in the years 1940—1944 (BOEREMA) may have been due to the decrease of frequency of obesity.

Peptic ulceration was more common (VEEN, PLATTEEL, STOLTE and BEAUMONT) due to a multitude of causes e. g. psychic tension, insufficient rest, malnutrition. Gastric ulcer increased more than duodenal ulcer (STOLTE and BEAUMONT, SCHWEITZER). JORDANS and SCHWEITZER observed cases of "ulcère géant".

*Deficiency of protein*

Because of the deficiency of calories and the absolute and relative deficiency of protein, body protein had to be used as a source of energy. Many of the phenomena of starvation were probably due to this, e. g. hypalbuminaemia, hunger oedema, lowered basal metabolism, psychic disturbances, capillary endothelial damage, muscular abnormalities and liver lesions with low immune antibody production (cf. BEATTIE). Infections thus took an abnormally unfavourable course. Diseases which had become rare, such as galloping phthisis and bilateral pleurisy, recurred. 10 % of the in-patients for starvation had tuberculosis.

Whereas the general resistance of the body improved but slowly after dietary treatment, the local mechanisms involving vasodilation rapidly returned to normal. Thus PIRQUET reactions, which had become negative during the starvation period in subjects known previously to have had positive reactions, reverted to positive again. This may indicate a specific dysfunction which may have accounted for the diminution during the starvation period of allergic manifestations (eczema, urticaria, asthma, migraine etc.) and for the increase of diseases in which temperature changes are thought to be involved, such as acute nephritis and acute rheumatism.

Hypothermia was probably due to protein deficiency. It was rapidly corrected by a diet rich in protein.

*Deficiency of fat*

This deficiency probably had some beneficial results. Gall bladder disease and acute pancreatitis declined in frequence early in the occupation and increased amazingly after the liberation (SCHALY). The change in the fat/carbohydrate ratio also was probably one of the causes of decline in diabetes.

*Deficiency of vitamins*

*A*. Although the blood levels were low, deficiency symptoms were rare. Mild cases of night blindness and some of follicular hyperkeratosis were seen. Severe deficiencies were almost unseen. Caroten icterus was not uncommon. Some of these cases had night blindness which reacted to vitamin A administration. There thus seemed to be in these cases a failure of conversion of carotene to vitamin A.

$B_1$. Although the diet towards the end of the occupation was somewhat low in thiamine and although the blood values were on the low side, saturation tests in most cases gave satisfactory results. Typical $B_1$ deficiencies were not seen and the cases of doubtful $B_1$ deficiency did not react to thiamin administration.

$B_2$. Riboflavine intake may have been low in some cases but on the whole the excretion values were not unsatisfactory. Definite cheilosis and fissuring were

not seen The stomatitis and glossitis seen with cases of diarrhoea reacted to nicotinic acid amide rather than to riboflavine

*Niacin* Although the intake of nicotinic acid in the food was on the whole fair, the low tryptophane intake and the diarrhoea favoured the development of pellagra Changes in the intestinal flora may have been of importance The complete picture of pellagra was not seen in the Western Netherlands but suggestive features were sometimes seen — the red painful tongue, stomatitis and irritability — which responded to injections of nicotinic acid amide The diarrhoea did not respond

*C* In spite of the deficiency in the food and of low blood values scurvy did not appear and the haemorrhagic diathesis did not respond to vitamin C

*D* The shortage of vitamin D caused some skeletal changes which have been discussed

*E, K and P* No signs of deficiencies of these vitamins were noted

*Recovery*

Recovery from most of the features of starvation was rapid After loss of the oedema fluid the weight increase in uncomplicated cases was rapid and steady In one series, three months after the liberation the average increase in weight was 14,3 kg Nitrogen retention was shown to have occurred Skin and muscle turgor returned remarkably rapid and the skin circulation equally so, indolent ulcers and furuncles became "active" and painful

Even after their return to normal weight many patients retained their tendency to develop oedema influenced by gravity It disappeared with rest associated with polyuria Hypalbuminaemia had long before been corrected and so could not have been the cause

Normal pulse rates and body temperatures were quickly restored, but the low values for blood pressure even in previously hypertensive subjects often persisted for longer periods The normal blood levels were only slowly regained The muscular tissue took some time for complete regeneration This was aided by exercise

The neuritis recovered gradually and completely, except that in a follow up examination many still complained of paraesthesia Psychic changes recovered well although the elderly still had some memory defects and mental fatigue Some 'nervous breakdowns" occurred when the patients resumed their normal occupations

Diarrhoea was frequently obstinate and liable to recur, giving a picture of "chronic enteritis" but this presented no bar to nutritional rehabilitation

Diabetes again became common with the increased rations Obesity also recurred In women it was often accompanied by amenorrhoea and in men by mastodynia The obesity was usually general but sometimes localised to the face and trunk and was associated with thin skin This suggested CUSHING's syndrome and may have been due to a failure of adaption of the adrenal cortex

F BIOCHEMICAL DATA

*Preface*

Several groups of investigators collected data concerning the biochemical and metabolic aspects of starvations The laboratory unit, under Dr J BEATTIE, working

in collaboration with the test ward established at the Municipal Hospital, the Hague carried out nitrogen balance studies investigated the relation of oedema to protein concentration in the blood, determined oxygen consumptions and made some heamatological observations (chapter VI, e, 1)

Dutch investigators working in laboratories in Amsterdam, the Hague, Rotterdam and Utrecht, covered a comprehensive range of blood and urine analysis, including vitamin determination, determination of basal metabolic rate and related studies (chapter VI, e, 2)

Section VI, e, 3 is taken from a preliminary report drawn up by Dr H SINCLAIR, the leader of this survey team As a report of nutritional conditions in the large Dutch towns Leiden and the Hague, it should form part of the section dealing with nutritional surveys as a whole, but since it contains the results of so many biochemical analysis — no less than twenty five thousand determinations were made in the laboratories at Leiden — it is thought to be more appropriate to bring these into closer relation with the other results of biochemical examinations by including extracts from the report in this section

It would have been convenient to bring together the data from the three sources and make one comprehensive report This course was ruled out, however, by consideration of the different composition of the groups of subjects studied The cases studied by Dr BEATTIE and his colleagues were, without exception in a very serious condition when admitted to the Test Ward They represented the terminal phase of starvation The Dutch data refer to groups examined at different periods of the occupation and individuals at different stages of nutritional decline These data are particularly interesting because some of the individual cases were followed up for re investigation three months after liberation Most of the records collected by SINCLAIR s unit concern the population of Leiden and The Hague in the latter half of May 1945 when the food situation had been materially relieved

The Editorial Committee decided therefore to present separate reports covering these three groups of investigations and to indicate in a final section some of the broad conclusions that could be drawn from a review of the data as a whole

### I BIOCHEMICAL STUDIES

#### Laboratory Unit Municipal Hospital, The Hague

The work of this unit was directed towards obtaining information on the relative values of protein and hydrolysed protein in resuscitating individuals in the last stages of starvation the effects of diets of different calorie and nitrogen contents on nitrogen retention and weight gain and on the starvation state itself Several studies of individual cases presenting unusual features were made

The laboratory work fell into two phases The first phase covered a period of less than 2 weeks during which patients admitted to hospital for treatment and study had not had access to food other than that available during the latter months of the German occupation This phase ended about May 31st 1945 The second phase began then when patients were admitted who had had access for about 2 weeks to rations which provided not less than 2 000 and not more than 2 500 calories per day Such patients were very emaciated but their clinical condition was better than those seen during the first phase

The experimental work was made up essentially of nitrogen balance experiments of short duration in the first phase and of much longer duration in the second phase Oxygen consumption determinations were carried out on as many patients and repeated as often as possible during the course of these experiments Biochemical determinations other than those necessary for nitrogen balance work included determinations of plasma protein levels, albuminglobulin ratios haematocrit and haemoglobin values, blood and urine urea concentrations, and plasma (or serum) non protein nitrogen values

*Subjects studied*

All patients admitted to the Test Ward were available for study by the Laboratory Unit After examination by two clinicians who satisfied themselves that cardiac, renal, pulmonary and infectious diseases were absent, a group of patients were selected The original plan was to use only adults of both sexes between the ages of 18 and 45 years for the various experiments Unfortunately for the work such persons formed but a very small number of those admitted as requiring medical care Many of them were unsuitable for investigation Consequently the group actually studied contained an unduly high proportion of elderly men Clinical records of the cases are given in Appendix Nr 28

On admission to hospital all patients admitted during the first phase (May) were placed on a diet devised by Dr DE JONGH of the Municipal Hospital during the German occupation which was known as the "Dr DE JONGH diet without eggs or milk"

The composition of this diet ,also that of all other diets used in this series of experiments is given in Appendix Nr 29

After a period of a few days at most the various experimental diets were commenced In a few instances it was possible to commence the experimental diets immediately on admission When these diets were commenced it was noted that a number of the patients developped diarrhoea This was almost universally present in some degree at some time during treatment Its occurence was not related to any one type of diet When it appeared during the course of a nitrogen balance experiment that experiment had to be terminated In this way the number of patients on whom work had begun was seriously reduced Adequate and accurate studies were possible on a small proportion of patients and in them only for a limited period The clinical histories of these patients are given in Appendix Nr 28

*The value of protein hydrolysates*

Two types of protein hydrolysate were provided for experimental use One was prepared by the acid hydrolysis of casein To compensate for that destroyed during hydrolysis, tryptophane was added at a later stage of manufacture The hydrolysate was provided in the form of a sterile solution containing 5 g per cent of dry hydrolysate, and was intended for intravenous use It was proposed to use this material in severely ill patients as the sole source of nitrogen Such experiments had to be abondoned as the material was found to produce extensive venous thrombosis The second type of hydrolysate was a powder to be used orally It had been produced by spray drying on enzymatic digest of casein and/or lean meat The inclusion of meat gave a much more palatable product than casein alone The powder was found

on analysis to contain 11,6 to 12,5 g nitrogen per 100 g powder as packed. All the *studies on hydrolysate feeding were carried out during the first phase.*

The hydrolysate was administered in solution with glucose. The amounts and concentrations have been set out in Appendix Nr. 29. The glucose used contained thiamin, riboflavin, nicotinic acid and ascorbic acid (see page 38). At first, feeding of the solution was given by nasal tube at a rate of about 5 ml/min. Shortage of skilled nursing staff made the rate difficult to control when large numbers were being fed in this way. Moreover it was found that patients preferred to drink their feeds rather than to have a nasal tube [illegible] for the greater part of their waking day. Drinking the feeds simplified [illegible] it required continuous supervision to ensure either that the dose prescribed [illegible] consumed or that if not wholly consumed the residue was measured and [illegible].

At the same time as administration of [illegible] hydrolysate was in progress another group of patients was being given [illegible] reconstituted milk powder and glucose. These milk diets had approximately the [illegible] and nitrogen contents as comparable hydrolysate diets. [illegible] also equal 2 litres. The first experiment was to feed a group [illegible] diets containing 6 g nitrogen and 6 g glucose for as long as [illegible]. Half of these patients received hydrolysate and the other half [illegible] experiment consisted in giving the above diets for [illegible] doubling the calories nitrogen of the diet. The latter level was [illegible] as long as it could be tolerated. Again nitrogen and calories [illegible] approximately equal in both the hydrolysate and milk diets. A third experiment consisted of the same treatment as above except that after [illegible] level the amount of nitrogen and calories were increased to three times the initial quantities. There were thus three experiments each divided into two [illegible] hydrolysate and the other on a milk diet. Each of these two groups [illegible] two young adults at the commencement of each experiment. Unfortunately the experiment could not be carried out as planned for three reasons: 1 [illegible] the patients developed severe diarrhoea, 2 some could not be induced to take the hydrolysates in the specified quantities, and 3 owing to scarcity of skilled [illegible] collections of excreta were not always complete.

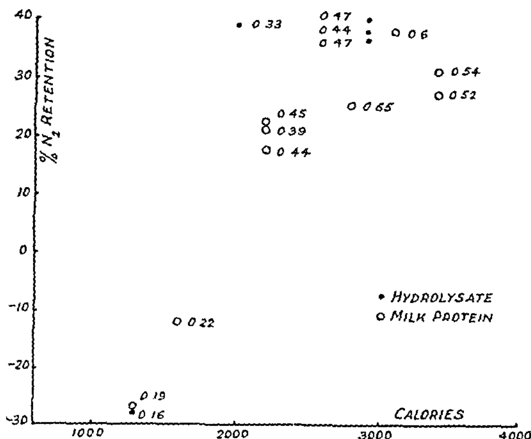
Ten balance *periods of 3 or more days* were completed. The results are given in Table 1 Appendix Nr. 30. *The relation of nitrogen retention to calories and to nitrogen input* are shown in fig. 47 and 48.

This number of completed experiments is too small to permit definite conclusions regarding the relative values of whole milk protein and hydrolysed protein. One can indicate some of the results shown in Table 1 Appendix Nr. 30. A negative nitrogen balance resulted when the intake of N daily was 5,9 g as hydrolysate (1 case) and 9,9 g as milk protein (2 cases). There was a positive balance on hydrolysate diets containing 11,5 g N (1 case) and 18,0 g (3 cases) and on milk protein diets containing 19,7 g N and 27—29,6 g N.

The evidence, scanty though it is, does not warrant the conclusion that hydrolysate was, under the experimental conditions, either absorbed or retained better than whole protein. The values for absorbtion and retention given must be treated with some reserve, for the difficulties inherent in collecting faeces over the short balance period were great.

By the time the technical difficulties of the experiment were surmounted the

FIG 47 Relation of percentage nitrogen retention to nitrogen intake in patients fed on hydrolysate or milk protein diets




critical period had passed and patients in a clinical state sufficiently serious as to justify the use of protein hydrolysate ceased to be admitted to the Test Ward

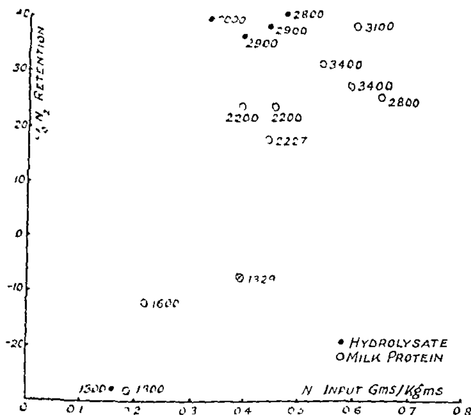
*Nitrogen balance experiments on varying diets*

The object of these experiments was to determine the various factors which influenced nitrogen retention and gain in weight As in the previous experiments these were essentially nitrogen balance experiments but with longer balance periods than those described in the previous series of studies

Daily intake faecal and urinary nitrogen excretions and body weights for each patient studied are given in Appendix Nr 31 fig 1—19

Where oxygen consumption determinations were carried out the basal heat productions per 24 hours are also shown During each balance period the calorie and nitrogen intakes were steady and the type of diet was unchanged In tables 2—4 (Appendix Nr 30) the total inputs and outputs are given both as daily averages over the period and also as the average calorie and nitrogen inputs per kilogram body weight Nitrogen retentions are also expressed as gms N per kilogram body weight The body weight value used was the mean body weight (daily weighings) over the

FIG 48 Relation of percentage nitrogen retention to calorie intake in patients fed on hydrolysate or milk protein diets




period This seemed justifiable as on the whole the rate of weight change was not great over each period

As no period of adjustment was possible on a particular diet, before the nitrogen balance on that diet was determined, it is necessary to realise that the nitrogen output rate tended to lag somewhat behind the nitrogen input rate This lag however was not great when succeeding diets were higher in calorie and nitrogen content it was serious when for any reason it was necessary to reduce the input levels Hence balance periods which fell into this latter category cannot be compared with corresponding periods in other subjects, where such periods represented a higher input level than that preceding them

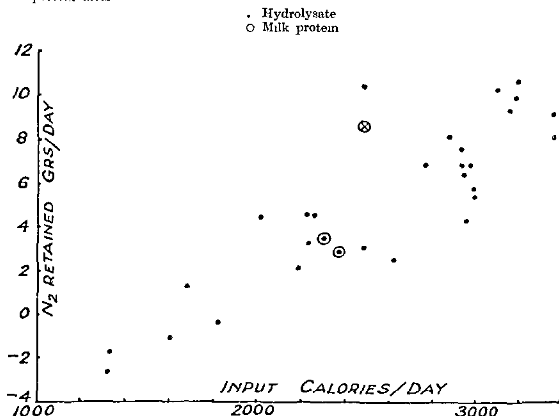
It was found that *in general* the nitrogen retention was proportional to the calorie input but not proportional to the nitrogen input Figs 49 and 50 The nitrogen balance was negative when nitrogen input was less than about 0,18 g nitrogen per kg and the calorie input less than around 32—35 cals per kg

If one or other of these inputs was less than these critical levels the balance was negative On nitrogen input levels in excess of the critical level the factor which determined the level of retention was the calorie input per kg There was evidence at a given calorie input level per kg the percentage nitrogen retention increased as

the ratio of nonprotein calories to protein calories increased until a ratio of 5 : 1 was attained The lower this ratio — in one experiment it was as low as 1,5 : 1 — the lower the percentage retention

Thus the sign of the nitrogen balance was negative when either calorie or nitrogen input or both were below the critical levels, but the efficiency (i e percen

FIG 49 Relation of nitrogen retention to calorie intake in patients fed on hydrolysate or milk protein diets




tage nitrogen retention) of any given diet was determined by the ratio of nonprotein to protein calories in the input, provided both the calorie and nitrogen inputs were above the critical level

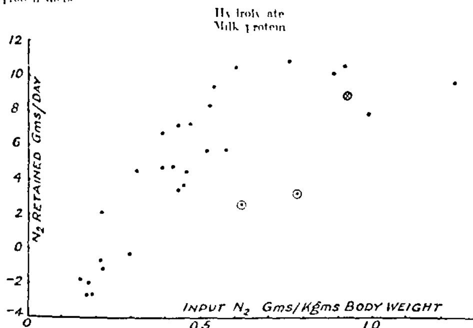
*Metabolic rate*

It is generally believed as the result of Benedict s work (1919) which has been examined critically by Lusk (1928), that in the starvation state the metabolic rate is reduced, whether that rate is estimated in terms of heat production per square meter or per kilogram bodyweight This belief however rests chiefly on an investigation on a series of subjects on reduced but not 'starvation" intakes for a relatively short period — 21 days Weight losses were small and did not on the average exceed 8,5 per cent Weight losses in the group of subjects studied in The Hague were much more serious and reached a level of 38 per cent of the normal weight

Under such conditions estimations of heat production in terms of surface area led to results which were not a true index of the rate of cellular oxydation Likewise changes in the ratio of active to inert material of considerable magnitude

take place when weight losses exceed 25 per cent of the normal weight As these points have been discussed in detail in other publications [1]), it is sufficient to state here that when metabolic rates are given they are the percentage changes in rates of heat production per kilogram bodyweight corrected for changes in active material per kilogram

FIG 0 Relation of nitrogen retention to nitrogen intake in patients fed on hydrolysate or milk protein diets




Seventeen patients were examined Determinations were made under basal conditions between 8 and 9 a m also between 3 30 and 4,30 p m on the same day The basal test took place not less than 13 nor more than 15 hours after the last meal This meal contained about 20 per cent of the daily input The mid day meal served at 12 30 p m contained not more than 50 per cent of the daily food intake Oxygen consumptions were carried out on the Knipping spirometer in the Metabolism Room by the staff of the Metabolism Department of the Hospital

The normal heat production was calculated from the standard heat production tables of BOOTHBY and SANDIFORD (1924) and the normal surface area computed from the DU BOIS and DU BOIS formula (1916) This normal heat production has been expressed as calories per 24 hours

As all the patients had some degree of training in the use of the apparatus, even at the first session a deduction of 5 per cent has been made from the standard heat production appropriate for the age and sex of the subject A further deduction of 5 per cent from the standard value was made in all subjects whose age exceeded 55 years

All the tracings made were submitted to Dr J D ROBERTSON of the Middlesex Hospital London, for his scrutiny Those records which were in his opinion of doubtful

[1]) See BEATTIE J, HERBERT P H (Brit J of Nutrition in the press) BEATTIE J BELL, D J HERBERT P H ibid

value were rejected At his suggestion it was decided to use the standard R Q of 0,82 instead of the R Q determined from the oxygen and carbon di oxide volumes[1]) His suggestions and advice were most helpful and have been gratefully received

The relevant data for the basal oxygen consumptions are to be found in table 5, Appendix Nr 30 Values for the oxygen consumption after food are given in table 6, Appendix Nr 30

When the results of the first tests were analysed it was found that heat productions per kilogram arised with the level of calorie input but not with the nitrogen input Only when calorie input fell below 35 cal/kg/day was the heat production per kilogram lower than the normal rate At levels above 35 cal/kg/day the rise in heat production was proportional to the calorie input

This conclusion however applied only to heat productions measured within 4 days after admission As treatment proceeded two trends were noted in the various patients Those who were maintained on a constant and high calorie input showed a tendency for the heat production to fall from its high initial level but even after 3—4 weeks treatment, heat production was above the normal rate In other patients where calorie input was raised step by step by intervals, the rate of heat production tended to increase with each successive rise in input

After food, heat production rose by variable amounts above the basal level for that day While most patients showed increases up to 40 per cent a few showed increases exceeding this One patient (T Sr) more than doubled his heat production The significance of the high metabolic rates on re alimentation and their further rise after food has been discussed elsewhere[2])

*Protein utilisation*

At the time of the oxygen consumption tests the urine output covering a period of about two hours was measured and the urinary nitrogen output per hour was determined by the semi micro Kjeldahl method The data obtained have been set out in tables 7 and 8, Appendix Nr 30

In the basal state the urinary nitrogen per hour was proportional to the nitrogen input of the previous day (fig 51) When the percentage of protein calories contained in the input was calculated, it was found that the percentage of calories in the basal production which came from protein, rose with the percentage of protein in the input (fig 52)

The amount of heat produced from protein in the output was calculated by multiplying the nitrogen output per hour by its calorie equivalent 26 51 cal per g nitrogen Examination of fig 52 shows that when protein provided around 40 per cent of the input calories the heat production from protein varied between 30 and 82

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[illegible] by other methods that deposition of fat took place at a very rapid rate during the [illegible] recovery from under nutrition

[2]) Beattie J and Herbert

FIG 51. Relation between nitrogen intake and protein calories metabolised

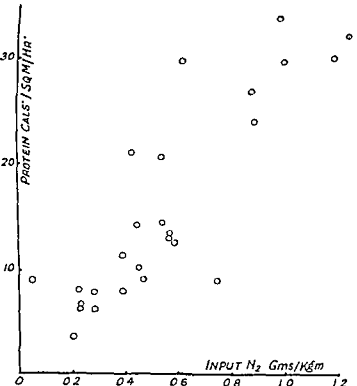
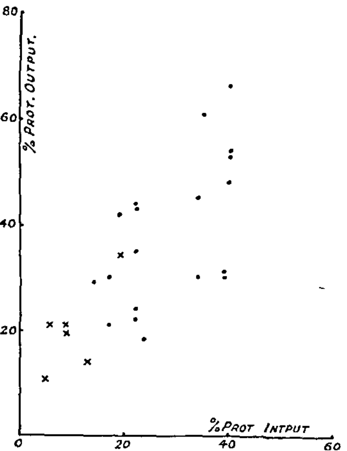


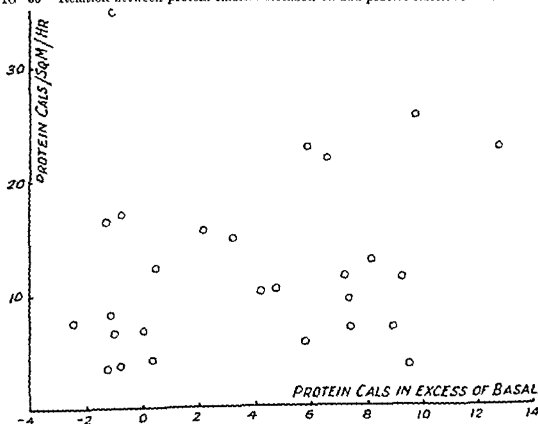

FIG 52 Relation between percentage protein intake and percentage protein output



per cent It was obvious that on some diets protein was being used largely as a source of energy

The protein input may be accounted for in the following ways 1 that lost in the faeces 2 that required for basal needs, and 3 a surplus over the basal requirements, part of which is metabolised and part conserved When the protein input is not sufficient for 1 and 2, then the patient must be in negative balance When there is a surplus over these two, then the proportion conserved will diminish according to the amount of this surplus which is metabolised for energy Eleven observations were made, where the amount of protein in the diet was less than that required for the basal requirements or just sufficient to meet them Sixteen observations showed an excess of input protein over basal needs, sufficient to provide between 2 and 13 protein calories per kg body weight Of these 16 observations, 10 gave basal heat productions from protein of between 3 5 and 13 cal per sq meter per hour when there was a surplus of protein calories between 4 and 10 calories per kg All ten observations indicated that the surplus of non protein calories over basal needs was 35 cal/kg and above Four of the 16 observations showed heat productions from protein in excess of 20 cal per sq meter per hour with an excess of protein in the input over basal needs sufficient to provide 6 to 13 cal/kg The excessive heat production from protein was explained by the finding that the input provided less than 35 cal/kg The protein sparing action of non protein foodstuffs was apparent on high protein inputs only, when there was sufficient non protein calories available to provide 35 cal/kg above the non protein basal requirements (fig 53) Under

FIG 53 Relation between protein calories metabolised and protein calories in excess of basal



these conditions protein conservation would tend to rise as the non protein calories in the input are increased

The importance of a high ratio of non protein to protein calories in the input has already been emphasised in the discussion on nitrogen balance

*Plasma and serum proteins*

These were determined by a standard KJELDAHL technique or by the specific gravity method of PHILLIPS and VAN SLYKE

The value obtained for total plasma or serum protein concentrations in 18 patients have been shown in table 9 Appendix Nr 30 The values for first and last samples are given It will be noted that even after prolonged treatment some values showed little change Nine patients had final concentrations within 0,2 g per 100 ml of the first value Eight of these patients however had concentrations, at the time of the first sample of 6 0 or more g % Two patients gave increases between 0 21 and 0 5 g five between 0 51 and 1 0 g and two over 1 01 g per 100 ml As might be expected the greatest increases were found when the initial concentrations were less than 6 0 g per 100 ml The rise in plasma or serum protein concentration cannot be related to the level of nitrogen input as the extent of the rise is determined largely by the initial concentration

For example patient B aged 48 years increased his serum protein concentration in 34 days from 5 1 to 7 25 g per 100 ml on a diet which on the average contained 157 g protein per day Patient I aged 36 years with an initial concentration of 7,0 g % (serum) had at the end of 22 days a level of 7 2 g % although the daily protein intake was 237 g protein

In table 10 (Appendix Nr 30) we have set out the albumin and globulin values determined in 17 patients While the globulin values have shown some variation the albumin levels tended to rise considerably during recovery Where large increases in protein concentrations were observed these increases were due mainly to the rise in the albumin level

If the values for albumin are differentiated into those associated with and those not associated with oedema the former are scattered over the range 4 6 to 2 09 g per 100 ml serum while the latter are between 4 8 and 3 2 g

*Relation of plasma protein levels to oedema*

The cases investigated were of three types

1 Four patients who had been in hospital for 6 to 12 weeks on the scanty hospital diet available before liberation

2 Eleven patients admitted 6 to 12 days after the liberation, who had been subsisting on the even more meagre civilian rations

3 Nine patients admitted 3 to 7 weeks after the liberation These patients had received the improved civilian rations or were transferred from other hospitals where an improved diet had been provided

With one exception all these patients either gave a history of oedema or were noted to have some degree of oedema on admission

From table 11 (Appendix Nr 30) it will be noted that none of the cases without clinical oedema had serum proteins less than 6 50 g % The cases with oedema had

total proteins varying from 4,60 g % (serum) to 7,78 (plasma) g % In only one case (F), however, was the total protein less than the so called critical oedema level of 5 g % total protein or 3 g % albumin This man, aged 77, was an extreme case of oedema Thus, while it cannot be denied that hypalbuminaemia may play a contributory part, it is obviously not the sole or the main cause of oedema Even the case F who had massive generalised oedema, simulating clinically gross nephrotic oedema, and hypoproteinaemia on admission responded to treatment so that the total plasma proteins rose in five weeks to 6,97 (plasma) g % and the albumin to 3,04 g % The oedema had markedly diminished but much still persisted with these plasma protein levels *In eleven other cases the plasma proteins were* followed for twenty six days or longer (table 12, Appendix Nr 30)

Thus, of the eleven cases followed for upwards of four weeks or more, seven showed a rise of plasma (or serum) proteins and four a fall Of the cases showing oedema on admission, six showed a rise in the concentration of plasma proteins and three a fall with rest and feeding In all these cases, except that of patient F, the oedema disappeared under treatment but was liable to recur after exercise These results tend to confirm the view that hypoproteinaemia is not the sole or the main cause of hunger oedema

*Composition of oedema fluid*

Oedema fluid was collected under paraffin in a test tube by needle puncture of the subcutis of the leg and drainage through a boiled rubber tubing, from which the air and carbon dioxide had been evacuated by negative pressure These samples were submitted for analysis to Dr DEKKER at Leiden, together with serum samples from blood collected under oil and separated within fifteen minutes Aliquots of these samples were retained and the $CO_2$ content and $CO_2$ combining power were estimated by the VAN SLYKE method Table 13, Appendix Nr 30, give results of the chemical analysis

Probably the most notable feature of these analyses of oedema fluid are the figures for the protein content They vary from 0,58 % to 0,82 % This is a somewhat higher figure than would be expected for a pure transudate and is comparable with the figure obtained in the oedema fluid from cases of congestive heart failure, where anoxia is also considered to be a causative factor for the oedema Certain other features of the oedema fluid analyses in conjuction with the serum analyses can be noted The inorganic phosphorus and the potassium figures are consistently the same in the serum and oedema fluid, whereas the calcium of the serum is consistently higher than that of the oedema fluid The sodium and chloride content of the oedema fluid is consistently but variably higher than that of the serum The serum sodium figures (apart from the reported value of 442 mg % on 21/6) are all reasonably within the normal range, as are the serum chloride figures

In the oedema fluid the sodium figures are frequently extremely high so that it is not always possible to balance the acid and base molecular proportions There is frequently an excessive base which is not balanced by bicarbonate It is notable that the non protein nitrogen figures were high throughout It is possible that some of the apparently anomalous figures are due to the nitrogen retention or to the presence of other metabolites in the oedema fluid, causing disturbance of the sodium estimation The analyses of specimens from 16/6 to 21/6 suggest that in

organic phosphorus and potassium as well as nitrogenous products are being abnormally retained

## Kidney function

*Urine Dilution Test*

Only one test designed to assess kidney function was carried out on a few patients during the early phase of our work. This was the dilution test which consisted in determining the volume and specific gravity of the urine hourly for 4 hours after drinking one litre of weak tea. The results have been set out in table 14, Appendix Nr 30. With the exception of one patient (v. V.) maximum excretion occured during the second hour. This was also the time when specific gravity of the urine was lowest. Patients v. V., Zn and Sp showed some delay in excreting the fluid given. Patient D showed a similar delay in the last test.

Low specific gravities in the second hour indicated that tubular function was adequate. Patient D on May 15 was an exception. The delay in reaching maximum output and the failure to excrete all the excess fluid within 4 hours, suggested that either the rate of renal blood flow or the area of filtration surface or both had been reduced.

*Non Protein Nitrogen*

In table 15, Appendix Nr 30, the NPN level (resting) in the serum taken under basal conditions and the nitrogen input on the day before in terms of grams nitrogen per kg bodyweight have been set out. The relation between these quantities has been shown graphically in fig 54. It will be noted that 18 out of 25 observations were above the average normal level given by PETERS and VAN SLYKE. Ten exceeded the upper limit of normal. Such high levels were not unexpected, in view of the exceedingly high protein inputs.

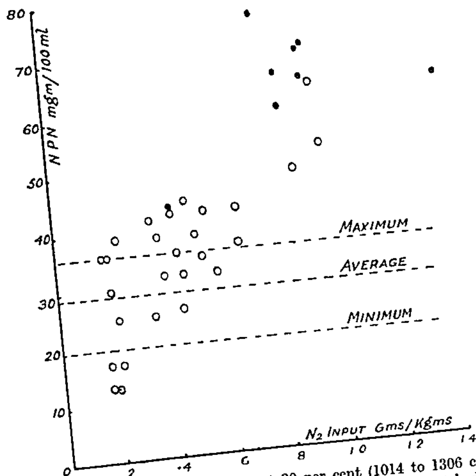
*Urea Clearance*

The urea clearance have been calculated on as many cases as possible for which the necessary data were available. Table 16, Appendix 30, was drawn up to show the urea clearance corrected to a uniform body surface of 1.73 sq. meters. The first five patients in this table were admitted to hospital during the middle week of May and consequently had not had access to increased rations before admission. The values obtained at the time of the first clearance determination were low, varying between one half and one third of the normal clearances. Where second estimations were made at a later date there was a substantial rise in the clearance values, although none reached the normal level. In the group of patients admitted in June four patients (Z, E, E and J) showed clearances which approximated to the normal values. The remainder gave low values but none so low as some in the May group.

The low clearance values indicate either that the volume of blood passing through the kidneys per minute was diminished or alternatively that the amount of urea removed from the renal blood was below normal. A reduction in renal blood flow by 50 per cent would account for the low clearances and the abnormalities noted in the urine dilution test.

An exception however must be made in the case of patient F. We have shown that in him the urea clearance remained at a low level over a whole month in spite

FIG 54 Non protein nitrogen of serum
• Hydrolysate treated patients
○ Milk protein treated patients




of a rise in oxygen consumption of about 30 per cent (1014 to 1306 cal/24 hours basal) with presumably an increase in cardiac output This patient had a massive oedema when admitted [illegible]d at the time of his last urea clearance estimation, oedema of both lower limbs [illegible] high calorie and protein diet and [illegible]mission [illegible]) that continued rest in bed [illegible]atient cleared within a few days It will be noted [illegible] this patient showed much higher NPN levels than those of any [illegible] especially on high nitrogen inputs On a comparatively low nitrogen input (0,42 g/kg) his NPN level was not unduly elevated As a matter of interest it must be pointed out, that the high nitrogen input levels did not increase his oedema In fact it was noted that diuresis commenced on the day the nitrogen input was raised from 14,1 to 51,3 g nitrogen per day The urine output on the former diet (13,6 to 15,1 g per day) ranged between 455 and 688 ml and on the latter rose to 2134 ml on the first day, 3520 ml on the second and continued at a high level around 2 litres a day for a month The fluid intake during the first diet period ranged between 800 and 1700 ml and in the second was maintained, with few exceptions at a constant level of 2100 ml

*Haemoglobin and Haematocrit values*

The haemoglobin concentration in the blood was estimated from the specific gravity of the whole blood as determined by the PHILLIPS and VAN SLYKE copper sulphate method The values obtained are summarized in table 17, Appendix 30 Haematocrit estimations from the same data are also included in this table The haemoglobin levels varied between 9.9 and 13.9 g per 100 ml blood It must be remembered that these values are derived from specific gravity values and their accuracy for this series of patients has not been checked by direct methods Cell counts were made on some of the patients and these values are included in the table

## 2 BIOCHEMICAL INVESTIGATIONS IN DUTCH LABORATORIES

Compiled from the reports of Dr STOLTE Amsterdam Dr DIKKENBERG, Amsterdam, Dr DROOGLEEVER FORTUYN, Amsterdam Dr DE JONGH The Hague, Dr SOFTERS, The Hague Dr BOK, Rotterdam Dr JONXIS Rotterdam, Dr HULST, Utrecht

by Dr J B STOLTE and Dr P L HOOGLAND

During the German occupation investigations concerned with studying the influence of starvation on the composition of blood urine and oedema fluid were carried out in several Dutch laboratories more particularly in those at Amsterdam (Dr STOLTE), The Hague (Dr DE JONGH) Rotterdam (Dr BOK) and Utrecht (Dr HULST) Conditions for such work were far from satisfactory There was a shortage of trained assistants and materials, whilst laboratory service were seriously inadequate When liberation came these conditions did not improve for some time, indeed, for the critical period of a few weeks laboratory work was further impeded by the necessity of dealing with more urgent matters

Nevertheless, a considerable quantity of data has been brought together from various sources It is by no means easy to bring them into perspective because some of the groups of subjects examined were not comparable For this reason, most of the figures given below, concern a group of about 250 patients suffering from starvation under clinical examination and a much larger group examined in out patients' departments by the clinicians mentioned by name

The group under clinical observation provided the more important data, particularly because the majority of the subjects were followed up and re examined three months after the first examination

The greater part of the analyses were made in the laboratory of Prof B C P JANSEN at Amsterdam, the remainder were made in the laboratory of Our Lady's Hospital in that city

The following paragraphs give a brief account of the observations

### *Vitamins*

*Vitamin A*

The vitamin A content of the blood of about 70 patients in the "starvation-ward" of Our Lady's Hospital, where Medical Feeding Team Nr 31 under Dr v D VALK was operating, gave an average figure of 10 I U per 100 ml In 29 cases of uncomplicated, serious starvation among these 70 patients, the average value was 12 I U per 100 ml, the distribution being

| *Vitamin A I U per 100 ml* | *Nr of cases* |
|---|---|
| 0 | 7 |
| 5 | 7 |
| 10 | 1 |
| 15 | 5 |
| 20 | 5 |
| 30 | 1 |
| 45 | 1 |

If 30 I U per 100 ml is regarded as the lower limit of normal values the group can be regarded as subnormal Dr J BOK recorded that 2 patients out of 9 serious cases at Rotterdam gave values less than 30 I U Dr HULST, at Utrecht, recorded 3 low values in seven examinations On the other hand Dr C L DE JONGH, in The Hague, found 20 out of 29 cases had concentrations higher than 30 I U per 100 ml

*Vitamin $B_1$ (Thiamine)*

The vitamin $B_1$ pyrophosphate content of the bloods of more than 50 starvation cases in the special ward at Amsterdam gave an average figure of 6,1 $\gamma$ per 100 ml The lower level of normal values is 6 $\gamma$ Twenty nine patients with serious but uncomplicated starvation gave the following data

| | *Cases* | | *$\gamma$ per 100 ml blood* |
|---|---|---|---|
| 29 | 22 with | oedema | 6,2 average |
| | 7 without | „ | 4,8 „ |
| 29 | 3 | | $< 3$ |
| | 10 | | $< 6$ |
| | 15 | | $< 9$ |
| | 1 | | 9 |

Analyses of urines gave a wide range of values 56—1080 $\gamma$ per 24 hours for 20 patients on admission to hospital with uncomplicated serious starvation The distribution was

| *Cases* | *$\gamma$ per 24 hours urine* |
|---|---|
| 5 | 100 |
| 5 | 300 |
| 4 | 600 |
| 6 | 600 |

The majority of the values are above the accepted normal range of 120—330 $\gamma$ and well above the critical beri beri level of 40 $\gamma$

Vitamin B excretion tests made after administration of considerable quantities of glucose [illegible] gave high levels, as [illegible] )0—1200 $\gamma$, was recorded by [illegible]

Two examples illustrate the figures obtained

| Day | Excretion γ per 24 hours | |
|---|---|---|
| | Case 1 | Case 2 |
| 1 | 500 | 107 |
| 2 | 700 | 80 |
| 3 | 1180 | 675 |
| 4 | — | 1000 |

Dr Bok obtained figures within the normal range for the pyruvic acid content of the blood of two starvation cases 2 1 and 1 8 mg per 100 ml respectively

*Riboflavin*

Twenty uncomplicated cases studied in the starvation ward at Amsterdam showed excretions on the day of admission to hospital ranging from 170—2750 γ per 24 hours The distribution was

| Cases | Excretions γ per 24 hours |
|---|---|
| 1 | < 250 |
| 5 | < 500 |
| 8 | < 1000 |
| 6 | > 1000 |

None of the patients gave a value lower than 120 γ which has been associated ith other signs of ariboflavinosis The average value 817 γ is comparable with r Emmerie s record of an average excretion of 952 γ (range 811—1250 γ) by normal ople The excretion of riboflavin rapidly rose when the starved patients were en a good diet The average excretion on the 2nd day after treatment had begun 1232 γ and that on the 3rd day 2327 γ Of 49 cases only 6 of whom 2 came institutions continued to show excretions at a lower level

Dr Hulst reported normal excretions of riboflavin by five patients examined trecht

ficance of the nicotinic acid content of blood and urine is were made Twenty three serious cases of star γ per 100 ml of blood with a range from 260— urine in three days by 20 cases averaged 1512 γ and 1206 γ for the third These figures Jansen as characteristic of normal indi tion cases in Utrecht and found excretion

lood of 44 patients in the starvation cated patients who did not show any day of admission or the following day was

| *Vitamin A I U per 100 ml* | *Nr of cases* |
|---|---|
| 0 | 7 |
| 5 | 7 |
| 10 | 1 |
| 15 | 5 |
| 20 | 5 |
| 30 | 1 |
| 45 | 1 |

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|---|---|---|---|
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| | 1 | | 9 |

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| 5 | 300 |
| 4 | 600 |
| 6 | 600 |

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Two examples illustrate the figures obtained

| Day | Excretion $\gamma$ per 24 hours | |
|---|---|---|
| | Case 1 | Case 2 |
| 1 | 500 | 107 |
| 2 | 700 | 80 |
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| Cases | Excretions $\gamma$ per 24 hours |
|---|---|
| 1 | $< 250$ |
| 5 | $< 500$ |
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| 6 | $> 1000$ |

None of the patients gave a value lower than 120 $\gamma$, which has been associated with other signs of ariboflavinosis The average value 817 $\gamma$, is comparable with Dr Emmerie's record of an average excretion of 952 $\gamma$ (range 811—1250 $\gamma$) by normal people The excretion of riboflavin rapidly rose when the starved patients were given a good diet The average excretion on the 2nd day after treatment had begun, was 1232 $\gamma$ and that on the 3rd day 2327 $\gamma$ Of 49 cases only 6, of whom 2 came from institutions continued to show excretions at a lower level

Dr Hulst reported normal excretions of riboflavin by five patients examined in Utrecht

*Nicotinic Acid*

Although the significance of the nicotinic acid content of blood and urine is by no means clear some analyses were made Twenty three serious cases of starvation gave an average value of 467 $\gamma$ per 100 ml of blood, with a range from 260—650 $\gamma$ The quantities excreted in the urine in three days by 20 cases averaged 1512 $\gamma$ for the first 24 hours, 1388 $\gamma$ for the second and 1206 $\gamma$ for the third These figures a little lower than those regarded by Prof. Jansen as characteristic of normal individuals Dr Hulst examined five starvation cases in Utrecht and found excretion in 24 hours to be from 2900—9100 $\gamma$

*Vitamin C*

The concentration of vitamin C in the blood of 44 patients in the starvation ward, averaged 0,32 mg per 100 ml Of 20 untreated patients who did not show any complications, the average was 0 36 mg on the day of admission or the following day The range was 0—1,2 mg % The distribution was

| *Cases* | *mg per 100 ml* |
|---|---|
| 9 | < 0,2 |
| 3 | < 0,4 |
| 8 | > 0,4 |

If 0,6—2,5 mg per 100 ml is regarded as the normal range and the lowest limit of normal as about 0,4 mg per 100 ml, then the amount of vitamin C in the blood of these patients was considerably too low Dr HULST also found low values in 8 starvation patients in Utrecht (0,2—0,35 mg/100 ml), in 10 others he found normal values (0,4—1,5 mg/100 ml) whilst Dr DE JONG found among 30 patients in The Hague 12 cases with less and 18 cases with more than 0,4 mg/ml In 1941 he obtained similar values in 20 normal adults, 9 less and 11 more than 0,4 mg/100 ml of blood

*Prothrombin Time*

The prothrombin time of 10 patients with uncomplicated and untreated starvation did not seem to differ essentially from that of three normal persons under observation It fluctuated between 26 and 38 seconds The amount of prothrombin in the blood could therefore be considered normal, presumably there was no shortage of vitamin K

*Serum Proteins*

Among 62 patients in the starvation ward in Amsterdam the average serum protein content was 5,4 g per 100 ml (albumin 3,2 % and globulin 2,2 %) Among 27 patients with serious, uncomplicated starvation in this ward, none of whom had been treated, the average percentage of protein in the blood serum was 5,2 g per 100 ml Twelve who were treated during the early days of liberation gave an average figure of 5,1 Fifteen cases treated after 2 weeks had an average content of 5,3 g per 100 ml The range of figures was from 3,2 to 6,8 % The percentage of total protein of 3 patients was lower than 4,0 g per 100 ml, of 7 others lower than 5,0 and of 16 others lower than 6,0 One patient had 6,8 g per 100 ml, which was caused by an abnormally high percentage, 3,7 g per 100 ml, of globulin

The average percentage of albumin in the serum of these 27 patients amounted to 2,9 g per 100 ml , whilst the average percentage of globulin was 2,3 g per 100 ml The range of figures for albumin was 1,7— 4,2 % and that of globulin between 3,7 and 1,4 % Two patients had less than 2 g of albumin per 100 ml of serum, 10 others less than 3 g and 12 others less than 3,5 g, the remainder had more Of 22 patients with starvation oedema, the average percentage of protein in the serum was 5,2, with average figures for albumin and globulin of 2,9 and 2,3 g per 100 ml respectively Of 6 patients who had the cachetic form of starvation without oedema the figures were 5,5, 3,2 and 2,3 respectively

In The Hague Dr DE JONGH found less than 6,5 g protein per 100 ml of serum in 33 of 53 starvation patients In 31 there was less than 3 5 g % of albumin In Rotterdam Dr BOK found in 42 starvation patients an average of 5,5 of total protein in sera with an average albumin globulin quotient of 0,786 In Utrecht, Dr HULST also found many low values of albumin

The sublimate titre of the serum of 62 patients in the starvation ward at Amsterdam averaged 1,41 In 18 the titre was below 1,2 and in 25 between 1,2 and 1,6 Twenty six patients with uncomplicated starvation gave an average figure of 1,53 In 4 the titre was below 1,2 and in 12 between 1,2 and 1,6

The range of normal figures is 1 6 to 2 2 Lower figures mostly coincide with hyper globulinaemia

*Sedimentation rate*

Dr HULST, working in Utrecht recorded figures for the most part below 15 mm On the other hand Dr BOK at Rotterdam and Dr DIKKENBERG at Amsterdam found relatively many high figures Among 60 patients in the starvation ward at Amsterdam under our care the average figure was 31 5 Eighteen patients gave records below 10 mm and 7 others below 20 mm

*Protein content of Oedema Fluid*

Three cases examined by Dr BOK gave the following protein contents 1,3, 0 81 and 0,42 %, whilst two cases in our care had fluid containing 0 68 and 0,70 % of protein respectively

*Non protein Nitrogen Compounds in Blood and Urine*

*N P N* Normal figures were recorded in Amsterdam in cases of uncomplicated starvation

*Uric Acid* Values ranged between 2 8 and 7,3 mg per 100 ml, with an average figure of 4 4 mg

*Urea* Usually low to very low figures were recorded but Dr BOK recorded relatively high figures when starvation was complicated by diarrhoea or dehydration

Table 19 summarizes the analyses of urine from starvation cases studied in Our Lady s Hospital, Amsterdam They were divided into two groups Group A consisted of 16 cases, of which 13 were studied for 3 consecutive days, who after admission were allowed to eat as much as they could They ate food providing at

TABLE 19 COMPOSITION OF URINE IN G/24 HOURS

| | Nitrogen g | | | | Urea g | | | | Ammonia | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Group A | 9 3 | 11 41 | 15 47 | 15 44 | 15 13 | 21 99 | 30 89 | 34 17 | 0 60 | 0 79 | 1 43 | 0 56 |
| Group B | 13 58 | 12 63 | 12 35 | 12 77 | 20 00 | 22 30 | 24 80 | 26 30 | 0 59 | 0 69 | 0 81 | 0,75 |

| | Uric acid | | | | Creatinin | | | | Phosphate | | | | Sulfate | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Group A | 0 248 | 0 282 | 0 259 | 0 264 | 0 85 | 1 00 | 1 24 | 0 84 | 0 260 | 0 463 | 0 340 | 0 381 | 2 19 | 1 81 | 3 33 | 2 95 |
| Group B | 0 602 | 0 400 | 0 438 | 0 306 | 1 [illegible] | 1 23 | 1 36 | 1 23 | | 1 018 | 1 107 | 1 16[illegible] | 3 01 | 3 98 | 3 11 | 2 49 |

Group A Diet rich in calories (< 3000) and protein (< 150 g chiefly milk protein)
B Diet 150 g of protein hydrolysate + 150 g of glucose (+ vitamins)

The *excretion of nitrogen in Group B corresponds to a utilisation of 84 9 78 8 77 2 and 79 8 g* of protein in the production of energy This group excreted less N and urea possibly less ammonia but rather more uric acid creatinine and phosphate than group A

least 3000 calories and 150 g protein daily Group B consisted of 9 patients each of whom was given 150 g of hydrolysed protein and 150 g of vitamin enriched glucose daily

*Blood sugar*

Dr DE JONGH's examination of 163 polyclinic patients gave a high proportion of low values Before the war, only about 3 % of patients gave figures below 0 08 % Dr DE JONGH s starvation cases contained 10 % of individuals with blood sugar contents between 0,05— 0,06 % and nearly a third of them were grouped with values between 0,06—0,08 % Some clinical cases in coma had levels in the range 0,02—0,05 % Only rarely could they be resuscitated by glucose transfusions

Dr BOK made studies of glucose tolerance in 37 patients Ten had a flat response curve, others showed prolonged rises above 200 mg % Only three patients showed a normal response

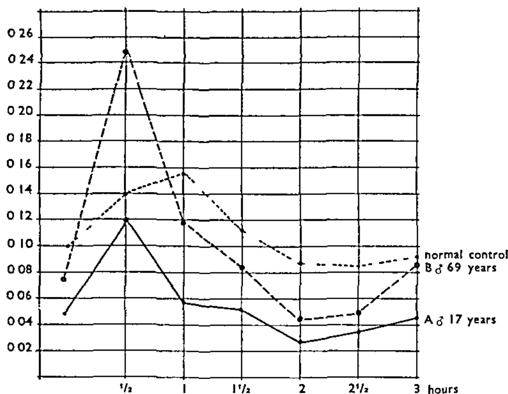
Studies in Amsterdam were restricted by lack of materials for making routine blood analyses Starvation cases were seen in an obviously hypoglycaemic state After a solution of glucose had been given intravenously they regained consciousness or lost their psychotic reaction Finally the patients relapsed into hypoglycaemic coma and died, in much the same manner as is seen in "myxoedemic coma" They no longer reacted to the injection of glucose It was not possible to make determinations of sodium and potassium In the weeks following, when it was possible to make blood sugar analyses again in the Amsterdam starvation ward, glucose tolerance tests were made on 16 patients who had been recently admitted The values determined when thepa tients were fasting were fairly low, averaging 0,072 % with a range from 0,05 to 0,09 % Remarkably often (7 times) the so called "lag curve ' of McLEAN was found, with an acute apex (> 0 200) in the first half hour In all cases the hypoglycaemic phase was very pronounced (figure 55) Sometimes the clinical features of hypoglycaemia were apparent No glucose was found in the urine during these tolerance tests

*Acetone*

Acetone was not found in the urine of any of the starvation patients examined by Dr BOK, Dr DE JONGH or Dr STOLTE This was true for the starvation period as well as for the period of treatment In two out of 33 patients Dr BOK found a reduced $CO_2$ combining power 18,5 and 22 3 vol % $CO_2$ respectively Dr DE JONGH and Dr STOLTE found normal values Determinations were not made on patients with very violent diarrhoea Dr DIKKENBERG found a few abnormal values for the $CO_2$ combining power in cases he studied

Dr HULST noticed that the reaction of 82 samples of urine taken from starvation patients before May 7th was 25 % acid, 18 % neutral and 57 % alkaline of 78 samples taken after May 7th 50 % were acid, 22 % neutral and 28 % alkaline A similar observation was made in the "starvation ward ' in Amsterdam, the urine of 92 patients who had entered the hospital before the liberation and who had not been treated and whose urine was examined soon after their entry into hospital was 17 % acid, 13 % neutral and 70 % alkaline Of 124 patients who entered after the second week of our liberation these figures were 49 28 and 23 So here also there was a tendency towards acidity

FIG 55 Glucose tolerance tests in 2 patients with hunger disease 2½ weeks after the beginning of treatment




*Galactose Tolerance Test*

In 14 cases Dr BOK found normal responses to the galactose tolerance test, but in Amsterdam 5 patients with serious uncomplicated starvation showed a diminished tolerance when the galactose tolerance test of FIESSINGER was applied

*Serum Cholesterol and Blood Lipoids*

Dr HULST, studying starvation cases in Utrecht, obtained the following groups of results

| | *No of cases* | *Serum cholesterol mg %* |
|---|---|---|
| Low | 2 | 104—118 |
| Normal | 27 | 140—190 |
| High | 46 | 193—350 |

Dr BOK in Rotterdam found an average value of 166 mg % with a range between 103—237, Dr DE JONGH in The Hague found a tendency to high values In Amsterdam, Dr STOLTI and his colleagues recorded more or less normal values, average 168 mg % range, 108—257

Dr BOK's determinations of blood lipoids (method of NICLOU) in 8 cases gave 162, 228, 325, 468, 625, 643, 925 and 1035 mg per l

Dr STOLTE and his associates found a tendency towards low lipoid phosphorus in the 28 starvation cases studied in Amsterdam The average figure was 8,4 mg per ml, with a range from 3,5 to 11,8 mg % Ten results were less than 7,5, the lower limit of the normal range

*Inorganic Constituents*

*Chlorides*

Chlorides expressed as NaCl in the blood plasma of 27 of our untreated patients with uncomplicated starvation, averaged 0,589 g per 100 ml Nineteen patients gave values within the normal limits 0,560—0,620, but 3 were higher and 2 lower It was not possible to show whether there was any correlation with hunger oedema or with diarrhoea Eleven patients, who received a salt poor diet rich in protein and providing ample calories, excreted in the urine in the first four days 12,8, 10,0, 10,3 and 5,7 g of salt respectively Nine patients, who were treated with a diet of 150 g of protein hydrolysate and 150 g of glucose in 3 litres of water excreted 26,2, 16,5, 7,7 and 3,5 g of NaCl in the first four days For both groups, when the first day of examination did not provide a full 24 hour urine, the quantity acutally collected was analysed and an appropriate factor applied There was no apparent relation between the excretion of chloride and the total volume of urine excreted

Dr DIKKENBERG also found a normal percentage of chlorides in the blood plasma of some patients in Amsterdam Dr Bok, on the other hand, observed lowered chloride content of plasma and erythrocytes in 10 patients In Utrecht, Dr HULST found 6,8—15,5 g NaCl per litre in the urine of 21 patients during the starvation period, which he considered "rather much" in connection with the small supply of salt In 3 cases studied by Dr BOK and 2 cases examined in Amsterdam, the percentage of chlorides in oedema fluid was about 4 g per litre

Dr HULST found the percentage of sodium and potassium in the blood serum of 5 patients with hunger oedema to be normal

*Calcium*

The percentage of calcium in the blood serum of 30 out of 40 starvation patients living in The Hague examined by Dr DE JONGH, appeared to be normal Of the others, one had 6,5 mg %, 5 had 7—8 and four 8—9 mg % Dr BOK found normal percentages of calcium The percentage of inorganic phosphate and phosphatase in the blood serum of his patients was normal In 54 untreated cases of starvation without important complications Dr STOLTE and his co workers found an average of 8,2 mg of calcium per 100 cc of serum The distribution was

| *Cases* | *mg Ca %* |
|---|---|
| 2 | < 6 |
| 6 | 6—7 |
| 11 | 7—8 |
| 21 | 8—9 |
| 14 | > 9 |

At the time of discharge the average of 14 of them was 9 1 per 100 cc There was a manifest correlation with diarrhoea with few exceptions the more recent

and the more frequent this symptom was the lower the percentage of calcium in the serum In a few of these patients normal titres for phosphatase and normal quantities of inorganic phosphate in the serum were found in others there was a somewhat high percentage of both The SULKOWITCH test often showed only a very small quantity of calcium in the urine of untreated patients Eleven patients with uncomplicated starvation who received a diet rich in protein chiefly from milk powder providing at least 3000 calories excreted 0 163 0 18, 0 240 and 0 217 g of calcium respectively in the urine during the first four days

The excretion by 9 patients who were fed on 150 g of hydrolysed protein and 150 g glucose with added vitamins in 3 litres of water amounted to 0 146 0 174 0 127 and 0 91 g on each of the four days This excretion of calcium ran parallel to the secretion of phosphate mentioned on page 137 for the first group 0 260 0 463 0 340 and 0 381 g per 24 hours for the second group 1 018 1 107 and 1 162 g The normal values for these excretions are 0 10—0 300 g calcium and 0 450—2 50 g of phosphate in 24 hours

*Haematological Data*

The percentage of haemoglobin was low in the majority of starved patients Thus Dr DE JONGH found 60—80 % Dr DIKKENBERG — using the photoelectric colorimeter — 60—65 % Dr BOK an average of 56 % (lowest value with negative benzidine reaction of the faece ... ) Dr HULST found a moderate anaemia ... treatment The average percentage of h ... with almost uncomplicated starvation was 9 6 g per 100 ml of blood (= 60 %) of 32 female patients 10 4 g (= 65 %) Of the 66 men 9 had less than 8 g 29 had 8—10 g 24 had 10—12 g and 4 more than 12 g Of the 32 women one had less than 8 g 10 had 8—10 g 16 had 10—12 g and 5 more than 12 g

The patients of Dr DE JONGH showed a colour index sometimes a little too high or too low Dr BOK mostly found a hypo or normo chromic anaemia out of 59 patients of Dr HULST 30 had an index of 1 05—1 4 21 an index of 1 and 8 an index of 0 74—0 95 Of the above mentioned 98 patients of our group with uncomplicated or almost uncomplicated starvation the index was also usually normo or hypochromic Hypochromic blood pictures were seen almost exclusively in complicated cases or in patients who had had an infection An index of 1 05 or higher (up to 1 27) was found in 63 % of our patients with almost uncomplicated starvation 21 % had an index between 1 05 and 0 95 and 16 % had a lower index (down to 0 78) If with OSGOOD indices between 0 85 and 1 15 are considered as being normal then 26 % were above and 4 % were below the normal range

The *diameter of the erythrocytes* was rather low under 7 4 $\mu$ in the cases examined by Dr BOK Dr HULST found normal to slightly macrocytic blood pictures In patients with uncomplicated starvation the diameter of 45 % of the cases was above normal (between 7 5 and 8 2 $\mu$) In 27 % the diameter lay between the normal limits (7 2—7 4 $\mu$) and in 28 % it was below normal There was a clear parallel between the magnitude of the diameter and the inclination to hyperchromia

Of 17 male patients with uncomplicated but serious or fairly serious starvation the different absolute values and indices were deduced from the amount of haemoglobin the number of erythrocytes per mm$^3$ of blood the haematocrit value and the average diameter of the erythrocytes (determined according to Dr BOK) *The*

*average quantity of haemoglobin per erythrocyte* was 35,7 γγ, with as extremes 28,8 and 40,1 γγ. *The average volume of the erythrocytes* was 119 $\mu^3$, with extremes 81 and 126 $\mu^3$. *The volume index* was 1,38 on an average. *The average corpuscular haemoglobin concentration* was 30 %, with a range 27 and 35 %, which probably shows a small shortage of iron. *The saturation index* was on an average 0,88. The average *thickness of the erythrocytes* was 2,55 μ, with extremes 1,97 and 2,88, which is rather high. We determined the number of *reticulocytes* of 14 patients. The percentage, related to the number of erythrocytes, varied between 0,40 and 1,56 %, the absolute number per mm³ of blood between 8200 and 48 800. The averages were 0,79 % and 21,050 % respectively. We examined the *fragility* of the red cells of 7 patients with uncomplicated starvation. It was fairly normal. Complete haemolysis was seen at 0,30—0,36, incipient haemolysis at 0,44—0,40. There were indications of slightly increased resistance.

The *percentage of iron* in the sera of a number of patients examined by Dr Bok were low, the highest value was 72,7 γ and the average 48 γ. Contrary to what was expected, Dr Hulst did not find any increased value in 7 determinations in the cases of hyperchromic macrocytic anaemia.

The *bilirubin content* of the serum of the patients seen by Dr de Jongh was normal or slightly subnormal. In 15 determinations Dr Hulst found an average of only 0,21 U, with variations between 0 10—0,50 U. In 69 patients with uncomplicated starvation we found an average of 0,63 U (= 0,315 mg per 100 ml), which is less than what we considered normal in our laboratory (0,4—1,2 U, with an average of 0,76 U). Ten patients had more than 1 U (of whom 4 more than 1,2 U), 37 had 0,4—1 U, 22 0,4 U or less.

The *urobilin reaction of the urine* of nearly all our patients with uncomplicated starvation was weak or very weak, bilirubin was not found.

The *leucocyte* counts of the patients examined by Dr de Jongh were mostly low (3000—4000/mm³). Dr Bok found the same in uncomplicated cases, he was struck *by the fact that even in cases of infectious disease the number of leucocytes* usually remained low.

Dr Dikkenberg noticed a strong inclination to *agranulocytosis*, which frequently necessitated stopping the administration of sulphonamides. Dr de Jongh found a normal ratio of the different forms of leucocytes but Dr Bok as well as Dr Dikkenberg, observed a relative lymphocytosis. In 7 out of 13 counts Dr Hulst, also found a tendency to lymphocytosis. Dr Stolte found in uncomplicated cases a less marked tendency to leucocytopenia and to relative lymphocytosis. Against the "normal" count of 6000—9000 leucocytes per mm³, he found an average of 5200 in 68 patients with extremes of 2800 and 11 200. It appeared that in all cases of infection the inclination to an increase of the leucocytes had diminished, although values up to 37,000 were found. In uncomplicated cases there was a relative lymphocytosis (average 38 %, extremes 18 and 56 %). The tendency to agranulocytosis, which Dr Dikkenberg had noticed, was not found in these patients. In the *differential count* the numbers of eosinophils and monocytes were fairly normal (average 2 4 and 3,5 %). The polymorphs showed a normal ratio of the rod and segment shaped nuclei. Toxic granulation did not occur.

*Sternal puncture* was performed on 19 patients with uncomplicated starvation. Erythropoiesis was normal qualitatively but diminished quantitatively. Megaloblasts were always absent. The *leucopoiesis* did not show anything remarkable, there

was no question of a check to maturation A good moderate number of megakaryocytes mostly mature, was found with normal formation of blood platelets Some slides showed a slightly increased proliferation of the reticulo endothelial elements, e g of the plasma cells

Because of the great frequency of cases of *haemorrhagic diathesis*, the test of RUMPELL LEEDE was widely carried out In Amsterdam, Dr STOLTE found that when the sphygmo manometer cuff was kept at the diastolic blood pressure for 10 minutes and then released, after a period of 5 minutes observation petechia were noted in the majority of cases Dr BOK and others using different technique, found a much lower incidence of positive results

The *blood platelets* were normal in form, but usually diminished in numbers — average 129 000 (FONIO s method) in 23 cases of uncomplicated starvation *Clot retraction, bleeding time* and *coagulation time* were normal The average *plasma fibrinogen* in 8 cases was normal (0,4 g per 100 ml)

*Gastro intestinal secretions*

Dr BOK carried out 37 *fractional test meal* examinations He found 19 patients with achlorhydria Of ten whose pepsin activity he examined, only one gave a negative result but 7 gave very low values Dr DIKKENBERG sometimes found achylia gastrica In 9 patients, to whom Dr STOLTE applied the fractional test, he found three cases of achlorhydria, of which one was even refractory to histamine The curve of four patients did not reach a value above 20

Dr STOLTE was able to aspirate *the duodenum* of 6 patients and to determine the diastatic and tryptic activity of the duodenal juice He obtained normal values The bile was also normal He had the impression that the quantity of the duodenal juice obtained was less than in normal persons In 4 cases Dr BOK determined the *percentage of lipase and diastase of the blood* and of *diastase in the urine* The findings were normal

*Faeces*

*Microscopic examination of the faeces* showed a fair amount of starch and undigested food residues in cases of diarrhoea examined by Dr BOK, notwithstanding a curative diet rich in fat no unusual amount of fat was passed nor did Dr DE JONGH find an abnormal quantity of fat in the faeces during recovery He found that 100 g of butter were very well tolerated Dr STOLTE examined the stool of 15 patients with uncomplicated starvation Nine had diarrhoea to a more or less serious extent The faeces of two patients with diarrhoea contained a slight excess of starch, the fermentation test giving a positive result No undigested muscular fibres were found In the stool of 6 patients with diarrhoea and of one without diarrhoea he found an excess of unsplit fat in the stool of 2 patients there was an excess of fatty acid soaps

*Basal metabolism*

Examining some of Dr HULST s patients, Dr JONGBLOED found in 19 determinations normal or somewhat low figures for basal metabolism When he took into account the influence of oedema the values were slightly higher In 57 determinations, made during or after treatment of the starved these values became manifestly higher and then went down again to about normal The basal metabolism

of 14 male patients with 'untreated' starvation were determined, using the Knipping apparatus These determinations were made after the 2nd week of the liberation when the food supplies improved somewhat Compared with basal meta bolism records for well nourished individuals of the same height, age and sex and weight, the figures tended to be low, the average being — 9,2 %

If allowance was made for the influence of oedema on weight, the average was — 5,7 % Compared however with the anamnestic weight before the war, it was — 20,5 % The respiratory quotient averaged 0 91

Even in 1942—43, when the rations supplied about 1600 calories daily, LIPS and FIZAAN, examining patients in Nijmegen, had found a reduction of basal meta bolism

The *temperature of the body* of the underfed had a clear tendency to be low In uncomplicated cases, we nearly always found the average to be about 36° C It did not respond to physiological and pathological influences Infections were characterised by small rises of temperature A man with typhoid fever ending in death never had more than a temperature of 37,8° C All patients complained about feeling cold Especially in the winter of 1944—45 the seriousness of this condition was very apparent, when patients with very low temperatures and in very bad condition came under treatment The temperature of babies whose regulatory mechanism is less stable than that of adults was frequently below 30° C In one case FORMIJNE c s saw a temperature of 26,9 Most of these patients died, not withstanding every effort to restore them

*Rehabilitation*

Particular interest is attached to some of the studies carried out at Our Lady s Hospital in Amsterdam, because a number of individuals who had been patients in the starvation ward there in the critical period of 1945 were re examined, three months after they had been discharged The second series of examinations revealed that their biochemical condition was normal The data for the two periods are conveniently compared below (table 20 and 21)

TABLE 20

AVERAGE CONTENT IN 34 HUNGERPATIENTS BY ADMISSION IN THE CLINIC AND 3 MONTHS LATER (in 100 ml serum or plasma)

| | Vitamin C (mg) | Aneurinepyro phosphate (γ) | Niacin (γ) | Vitamin A (I U ) | Carotenoids (I U ) | Total protein (g) | Albumin (g) | Globulin (g) | Uric acid (mg) | Phosphatase (KING & ARMSTRONG U ) | Anorgan phosphate (mg) | Lipoidphosphate (mg) | Sodiumchlorid (mg) | Haemoglobin (g) (men) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average admis sion | 0 26 | 5 8 | 485 | 13 | 28 | 5 4 | 3 1 | 2 3 | 4 7 | 7 2 | 4 42 | 8 6 | 584 | 8 8 |
| Average after 3 months | 0 95 | 9 9 | 610 | 89 | 71 | 7 0 | 4 3 | 2 7 | 5 0 | 5 8 | 4 21 | 10 3 | 607 | 14 8 |

TABLE 21

CONTENT IN 100 ML BLOOD OF 106 RESTORED STARVATION CASES 3 MONTHS AFTER LIBERATION (AUGUST 6 1945)

| | Vitamin C (mg) | Aneurinepyrophosphate (γ) | Niacin (γ) | Vitamin A (I U) | Carotenoids (I U) | Total protein (g) | Albumin (g) | Globulin (g) | Uric acid (mg) | Phosphatase (King & Armstrong U) | Anorgan phosphate (mg) | Lipoidphosphate (mg) | Calcium (mg) | Sodiumchlorid (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average content | 1,27 | 9,7 | 609 | 90,6 | 87,6 | 6,9 | 4,3 | 2,6 | 5 | 5,9 | 4,50 | 10,25 | 8,2 | 602 |
| Range | 0,05 | 3,6 | 420 | 0 | 4 | 8,2 | 5,4 | 3,6 | 7,3 | 14,0 | 5,75 | 14,1 | 6,8 | 681 |
| | 1,80 | 14,3 | 810 | 170 | 288 | 4,9 | 2,9 | 1,8 | 3,0 | 2,8 | 3,05 | 7,0 | 10,0 | 504 |

*Vitamin A*

Whilst the content of vitamin A at the first examination varied between 0,0 and 50 I U per ml it lay between 31 and 156 at the second examination

| | Number of patients | 0 10 U | 11 20 U | 21 30 U | 31 50 U | 51 100 U | >100 U | Average |
|---|---|---|---|---|---|---|---|---|
| On entering hospital | (33) | 16 | 11 | 4 | 2 | 0 | 0 | 13 U |
| 3 months later | (25) | 0 | 0 | 0 | 2 | 16 | 7 | 89 U |

*Carotenoids*

| | Number of patients | 0—20 U | 21—50 U | 51—100 U | > 100 U | Average |
|---|---|---|---|---|---|---|
| On entering hospital | (33) | 15 | 14 | 4 | 0 | 28 U |
| 3 months later | (27) | 1 | 12 | 10 | 4 | 71 U |

*Vitamin $B_1$ — Aneurinpyrophosphate*

| | Number of patients | 0—2 5 γ | 2 6—6 0 γ | 6,1—1 00 γ | > 1,00 γ | Average |
|---|---|---|---|---|---|---|
| On entering hospital | (29) | 2 | 8 | 17 | 2 | 5,8 γ |
| 3 months later | (31) | 0 | 1 | 17 | 13 | 9,9 γ |

*Nicotinic acid*

| | Number of patients | 0—300 γ | 301—500 γ | 501—700 γ | > 700 γ | Average |
|---|---|---|---|---|---|---|
| On entering hospital | (22) | 3 | 7 | 12 | 0 | 485 γ |
| 3 months later | (31) | 0 | 4 | 20 | 7 | 610 γ |

*Vitamin C*

| | Number of patients | 0,00—0 25 mg | 0,26—0,50 mg | 0 51—0 75 mg | 0,76—1,00 mg | > 1,00 mg | Average |
|---|---|---|---|---|---|---|---|
| On entering hospital | (21) | 13 | 3 | 4 | 0 | 1 | 0,26 mg |
| 3 months later | (32) | 4 | 4 | 2 | 6 | 16 | 0,95 „ |

There is, therefore, an all round improvement in respect of the vitamins It is most pronounced in the case of vitamins A and C, but some patients were still in an unsatisfactory condition in respect of C after 3 months

*Serum proteins*

| | Number of patients | 0–4 0 g | 4,1–5,0 g | 5,1–6 0 g | 6,1–7,0 g | 7,1–8,0 g | > 8,0 g | Average |
|---|---|---|---|---|---|---|---|---|
| On entering hospital | (33) | 2 | 8 | 20 | 3 | 0 | 0 | 5,4 g |
| 3 months later | (27) | 0 | 1 | 1 | 11 | 13 | 1 | 7,0 g |

*Serum albumin*

| | Number of patients | 0–2 0 g | 2,1–3,0 g | 3,1–4 0 g | 4,1–4,5 g | > 4 5 g | Average |
|---|---|---|---|---|---|---|---|
| On entering hospital | (31) | 2 | 11 | 16 | 2 | 0 | 3,1 g |
| 3 months later | (17) | 0 | 1 | 11 | 10 | 5 | 4,3 g |

*Serum globulin*

| | Number of patients | 0–1,5 g | 1,6–2,0 g | 2 1–2 5 g | 2,6–3 0 g | > 3,0 g | Average |
|---|---|---|---|---|---|---|---|
| On entering hospital | (31) | 1 | 7 | 14 | 8 | 1 | 2,3 g |
| 3 months later | (17) | 0 | 3 | 3 | 9 | 2 | 2,7 g |

It will be noted that the rise in serum protein is due more to albumin than globulin, the figures for which did not fall as did those for albumin during starvation Some of the patients still showed low concentrations of blood albumin after three months

*Uric acid* This showed no significant changes

| | Number of patients | 0—2 0 mg | 2,1—4 0 mg | 4 1—6 0 mg | > 6 0 mg | Average |
|---|---|---|---|---|---|---|
| On entering hospital | (28) | 0 | 10 | 15 | 3 | 4,7 mg |
| 3 months later | (28) | 0 | 4 | 20 | 4 | 5,0 „ |

*Inorganic phosphate* Unimportant differences

| | Number of patients | 0 2 00 mg | 2 05–3 00 mg | 3 05–4 00 mg | 4 05–5 00 mg | 5 05–6 00 mg | >6 00 mg | Average |
|---|---|---|---|---|---|---|---|---|
| On entering hospital | (33) | 0 | 3 | 9 | 12 | 6 | 3 | 4 42 mg |
| 3 months later | (30) | 0 | 0 | 10 | 18 | 2 | 2 | 4 21 |

*Lipoid phosphate*

| | Number of patients | 0 5 0 mg | 5 1 7 0 mg | 7,1–9 0 mg | 9 1–12 0 mg | > 12 0 mg | Average |
|---|---|---|---|---|---|---|---|
| On entering hospital | (30) | 3 | 6 | 10 | 12 | 2 | 8 6 mg |
| 3 month later | (30) | 0 | 0 | - | 18 | 4 | 10 3 |

*Phosphatase* A return to accepted normal limits

| | Number of patients | 0 5 0 U | 5 1—7 5 U | 7,6—10 0 U | > 10 U | Average |
|---|---|---|---|---|---|---|
| On entering hospital | (32) | 8 | 9 | 11 | 4 | 7 2 U |
| 3 months later | (24) | 8 | 11 | 5 | 0 | 5 8 U |

*Chlorides* The percentage of *chlorides* showed the following changes

| | Number of patients | < 560 mg | 560—620 mg | > 620 mg | Average |
|---|---|---|---|---|---|
| On entering hospital | (33) | 7 | 23 | 3 | 584 mg |
| 3 months later | (19) | 0 | 16 | 3 | 607 „ |

The few low values have disappeared

*Haemoglobin*

| | Number of patients | < 6 g | 6 1 9 g | 9 1 10 g | 10 1–11 g | > 11 g | Average |
|---|---|---|---|---|---|---|---|
| On entering hospital | (28) M<br>(4) F | 7 | 10 | 7 | 3 | 1 | 8 8 g<br>10 4 g |
| 3 months later | (28) M<br>(4) F | 0 | 1 | 1 | 4 | 22 | 14 8 g<br>14 6 g |

Improvement had clearly occurred, but all the values are not yet normal

*Calcium*

A re determination of serum calcium in this special group of patients was not made A comparison of the percentage of calcium of 14 patients on entry and on discharge from hospital about 2½ weeks later, was however possible

| | Number of patients | 5 0— 7 0 mg | 7,1— 8 0 mg | 8 1— 9 0 mg | > 9 0 9 0 mg | Average mg |
|---|---|---|---|---|---|---|
| On entering hispotal | (14) | 2 | 2 | 9 | 1 | 8,1 mg |
| 2½ weeks later | (14) | 0 | 1 | 5 | 8 | 9 2 mg |

Most of the figures had come within the normal range Hence the urine in any arbitrary portion, always showed a turbidity with the "reagent" of SULKOWITCH The *reaction* of these urines was usually acid or "neutral" *Acetone* was not found

Dr BOK found that the stomach of patients who had shown achylia gastrica as a result of starvation, soon secreted acid after treatment began Dr STOLTE found some excess *fat in the faeces* (mainly fatty acid soap) of a few patients after 3—4 months

As mentioned, Dr JONGBLOED observed a transitory rise of the *basal metabolism* above normal during the treatment Dr STOLTE found a diet of high caloric value and protein content caused a rise in the consumption of the $O_2$ by fasting patients at resting and also by patients who were not fasting and not fully resting, although in bed The *respiratory quotient* also seemed to rise considerably, in some cases it rose even to above 1 (table 22)

Fig 56 demonstrates the course of body weight, pulse rate temperature and micturition during the first days of treatment

FIG 56 Weight, daily mean of temperature and pulse frequency and daily output of urine in G a man of 66 years with pure hungeroedema and no diarrhea

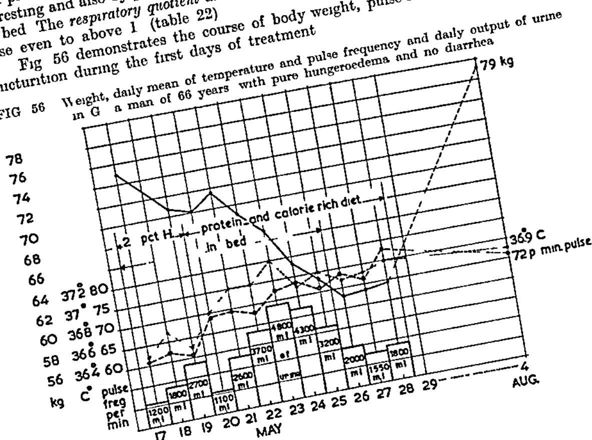


TABLE 22

INFLUENCE OF DIET ON METABOLISM IN HUNGERPATIENTS

| | Sex | Age | lenght (m) | weight (kg) | weight without oedema | Diagnose | Diet | Fasting: litres $O_2$ (abs) in 10min | Fasting: Cal. per 24 h. | Fasting: R Q | Not fasting: $O_2$ (abs) in 10min | Not fasting: Cal per 24 h | Not fasting: R Q | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S. | Male | 37 | 1,80 | 74,4<br>74,9 | 74,4 | normal<br>control | usual diet<br>4th day P | 2,41<br>2,49 | 1738<br>1810 | 0,94<br>0,98$^5$ | 3,08<br>3,23 | 2205<br>2333 | 0,90<br>0,96 | 18 h<br>18 h |
| V. | Male | 59 | 1,73 | 52,6<br>48,4 | 44,5 | hungeroedema | 3d day 2½ % H<br>after 3 weeks P | | | | 1,79<br>2,63 | 1255<br>1891 | 0,79<br>0,92$^5$ | 10 h<br>10 h |
| H. | Male | 60 | 1,74 | 57,8<br>57,4 | 56,5 | hungeroedema<br>hypertr. prostate | 2d day 7½ % H<br>9th day P | 2,01<br>2,42 | 1395<br>1464 | 0,74<br>0,97$^5$ | <br>2,80 | <br>2044 | <br>1,08 | <br>15 h |
| R. | Male | 65 | 1,65 | 60<br>59 | 54 | hungeroedema | 2d day 7½ % H<br>after 2 weeks P | 1,94<br>2,68 | 1379<br>1919 | 0,86$^5$<br>0,90 | <br>3,95 | | | |
| F. | Male | 55 | 1,65 | 41,7<br>43,9 | 41,7 | chachectic | 2d dag P<br>7th day P | 1,66<br>2,13 | 1205<br>1555 | 0,98<br>1,00 | 2,54<br>3,03 | 1854<br>2212 | 1,00<br>1,06 | 18 h.<br>18 h |
| K. | Male | 80 | 1,63 | 47,7<br>46,9 | 44,5 | hungeroedema | 2d day P<br>7th day P. | 1,56<br>1,76 | 1104<br>1285 | 0,84<br>1,00 | 2,40<br>2,55 | 1735<br>1861 | 0,95$^5$<br>1,02 | 17h 30<br>17h 30 |
| A. | Male | 39 | 1,66 | 53,6 | 40,9 | hungeroedema | 2d day 7½ % H | 1,97 | 1399 | 0,86 | 2,37 | 1685 | 0,87 | 10 h |

### 3 INVESTIGATIONS OF THE OXFORD NUTRITION SURVEY TEAM (c)

Extracts from Report by Dr H SINCLAIR

The form of survey used by the Oxford Survey Team was, in outline, as follows Streets to represent the three main social classes (high, middle and low) were selected by the Public Health authorities of Leiden and The Hague A random sample of subjects in each street was medically examined at the clinic set up in a suitable institution Nearly all persons gave a blood sample for biochemical analysis, and on many a dark adaptation test was done Certain functional and body measurements were made, and photographs were taken on specially selected subjects Detailed dietary enquiries were made of a high proportion of the subjects

Two days, a Saturday and Sunday, were spent in obtaining general information about the food supply in the city, and in visiting institutions, and six days in Leiden, and eight days in the Hague were spent in clinics

In addition to the routine surveys of the general population, stress groups were specially investigated, these included old people, dwellers in institutions, pregnant and lactating women and children A special survey was made on the occupants of a ward in the Academische Ziekenhuis, Leiden, in the care of one of the Feeding Teams of the Netherlands Red Cross

In Leiden and The Hague it was expected that malnutrition might be found to be unequally distributed among the three main social classes, in view of their different opportunities and means for buying in the black market It was therefore desirable to obtain a picture of each city as a whole by examining the dwellers in streets representing different social classes We were informed that social classes did not necessarily correspond with economic groups the lower classes were said to deal more in the black market

In Leiden the public health official informed us that 95 % of the population of 80 000 was ' poor and 5 % "wealthy" It was then agreed that the team should hold six clinics two in very poor areas (annual income about 500—700 guilders *per annum*), one in a poor area (700—1000 guilders), two in middle class areas, and a small clinic in a rich area, suitable areas were selected by the Public Health officials A reasonable number of persons to give a representative sample of the city was 1000 [1])

In The Hague the Director of Public Health suggested that clinics should be held in seven streets, each of different social class from the poorest to the richest An eight slum street was added at the end A reasonable number of persons to examine was considered to be 1500 [1])

After the streets had been selected, social workers were allotted to them and visited them on the day before a clinic Appointments for attendance at the clinic were made with every member of every house in the street until (usually) about 200 appointments had been made

On arrival at the clinic each subject was met by a social worker, and was given a numbered form on which were recorded particulars of identification, age and occupation On the list of household appointments the social worker noted the reasons for the absence of anyone for whom an appointment had been made,

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[1]) Details of the clinics and the numbers investigated are given in app 32 table 1 and 2

having questioned a relative or neighbour about such absence Information for every individual in the area was thus obtained (The Dutch clinician subsequently examined all the sick people at home or in hospital and obtained blood samples The inclusion of absentees from the clinics in the investigation was essential for a balanced picture of the nutriture of the selected group, as most of the absentees were in a state of health inferior to that of those who attended Care was taken that the examination (including biochemical examination) of those ill at home was identical in all relevant particulars with that of those attending the clinic)

Weight and standing- and sitting height were then measured and entered direct on the subject's form which he took with him throughout the clinic After this every third household was directed to the Dutch dietist who enquired from the person who prepared the food for that household the actual intake of food for the whole household during the previous week The social worker, who had initially contacted the subjects at their houses, then explained the forms upon which they were asked to record all food eaten by the family during the next three days, and she wrote on the forms the name and day on which they were to be used She then promised to visit the household the following day All subjects went to the senior medical student who recorded on the individual forms present symptoms and complaints and illnesses in the past year A second medical student measured blood pressure

The subject was then examined clinically and a note of any required special tests such as photography or dark adaptation was added to the form If any such tests were also being done upon a random sample of the subjects, the two groups were kept quite separate for purposes of computation

Samples of blood were then drawn from the subjects From most children and some adults blood was obtained from a finger prick From most adults and certain children, blood was obtained by venepuncture There were almost no refusals

Dark adaptation tests were performed either in the clinics or in the mobile laboratory, on a random sample of the subjects and on certain subjects specially selected during the clinical examination

When other tests were done such as capillary fragility, X ray examinations, photographs or the bar test they followed the measurement of dark adaptation

### *Dietary*

That there had been a lack of food in Leiden and The Hague was obvious The problem was to discover its duration severity and effects, with particular relation to the classes of people affected and the nutrients involved Three types of dietary investigations were undertaken

*a* Inquiries were made into the food consumption of all age groups and classes, including pregnant women and nursing mothers, invalids, and inhabitants of institutions such as orphanages nunneries and old people's homes These inquiries covered three months September 1944 at the beginning of the deterioration of the food situation February 1945 when food and fuel were most scarce and April 1945, at the end of the 8 months deprivation, and immediately before the capitulation of the Germans The results of this general investigation were expected to give a picture of the whole food situation during the months of occupation and to assist the interpretation of the clinical functional and biochemical findings

*b* As the dietary investigation started on 24 May and the food position was already improving, more detailed information was necessary on the food eaten immediately before the examination at the clinic since the levels of nutrients in blood, for example, are affected by the immediate past diet Food consumption during the preceding week was therefore recorded

*c* Family records of food consumption were made to discover what people were eating at the actual time of the investigation These records covered the three days following attendance at the clinic

The final results of the dietary investigation were expressed in specific nutrients protein, animal and vegetable fat, carbohydrate, calcium, phosphorus iron, carotene, vitamin A, thiamine, niacin, riboflavin, ascorbid acid

For all foods grown in the country upon which analyses were available, the Nederlandse Voedingsmiddelen Tabel ("Voeding", 15 October 1941) was used Figures for niacin and riboflavin in these foods were not included in this table and were mainly taken from the tables in *Nutrition and Relief Work* (London, OUP, 1945) These tables were also used for obviously foreign foods, e g Army biscuits and tinned meats and for other foods for which Dutch values were not available Allowances were made for the inedible portion discarded in preparation No allowance was made for vitamin losses in storage and in cooking, except in the cases of ascorbic acid where allowances had already been made in the Dutch tables, or for the non availability of some nutrients in certain foods We should add that we used these tables because requested to do so in order that our results would be comparable with other results obtained by Dutch workers The tables undoubtedly allow exaggerated losses in preparation and we do not accept the erroneous practice of calculating calories by using ATWATER's general factors 4, 9, 4, such a method of calculation undoubtedly overestimates the calories in the type of diet available

The official food available in the three months of September 1944, February and April 1945 was calculated *per caput per diem* in the different age group, and for pregnant women and nursing mothers (see p 149)

The calculation of the previous week's diet was shortened by building it up from the official ration previously calculated in age groups for the 7 days and used as such Central kitchen food and (in The Hague) I K B food were similarly calculated for the 7 days from constituents Each individual diet was treated separately Extra food was calculated either as eaten *per caput* if recorded as such, or computed from family coefficients, the whole was then added and divided by seven to give nutrients *per caput per diem*

The separate items on the three day diet record sheets were transferred to a calculation sheet printed with common food items in the same order as in the food composition sheet (to simplify identifying a food), this being possible only because of the small number of different foods available A space was left for less common foods, this space gradually became more and more used up with the introduction of different items as the food situation improved This gave the total food for a household for three days By dividing by three and computing by means of family coefficients (League of Nations) the nutrients *per caput per diem* were obtained Diets of children under four years were calculated separately

### *Clinical*

The clinical examination was design be due to nutritional deficiency within such signs objectively unless he was ce they had a non nutritional cause

The symptoms were recorded by a senior Dutch medical student who asked the subject what complaints, if any he had at the time of the interrogation He then enquired into illnesses during the past year, recording in every case whether the subject had had diarrhoea in the winter Then enquiries were made concerning the following muscle pains or cramps including pain on rising from a chair, sore tongue, history of oedema paraesthesias chronic fatigue or weakness, diarrhoea rapidly failing vision sore eyes menstruation and lactation

After this interrogation the subject was examined either by Dr SINCLAIR or by Dr BOIST at the start of the survey and at the end many subjects were examined by both to compare criteria, and during the course of the examinations signs of particular interest or doubtful significance were examined by both Because of the impossibility of obtaining complete uniformity, the record card was initialled by the clinician making the examination At the last clinic the Dutch physician from the U S team Dr VAN ANDEL joined the examination all subjects being examined by two of the three clinicians Subjects were examined with arms and lower legs bared

Table 5 app 32 reproduces the standard card used for recording data by the Oxford Nutrition Survey It was speciall ydevised forrapid surveys for public health purposes The card can be rapidly sorted in the field on the Cope Chat principle and can be used for more detailed mechanical sorting when the results have been punched on Hollerith cards

Unfortulately almost all the early signs and symptoms of nutritional deficiency are unspecific and even the late signs accompanying certain deficiencies, such as of vitamin A are not pathognomonic It is therefore necessary to record the signs and make a diagnosis upon the combination of them and the confirmation afforded by supporting investigations such as biochemical estimations

Almost all the persons upon whom a test was performed were examined clinically, the only exceptions being re test for dark adaptation or X ray examinations Over 3300 clinical examinations were performed

### *Functional*

1 *Dark adaptation*

Where a suitable room was available in the clinics this was darkened and used otherwise dark adaptation tests were done in the mobile laboratory, which had been fitted with screens and curtains for this purpose

Dark adaptation in this context means the rod threshold of the dark adapted eye The test as used consisted in measuring the smallest amount of light which a subject could detect after a minimum of twenty minutes in a completely dark room The test field used on the retina was 2 5° in diameter fixated 6° above the fovea The machine was modification of WALD s apparatus results are independent of intelligence are closely reproducible and cannot be affected by an uncooperative subject

After at least 20 minutes of dark adaptation the subject looked into the mask of the adaptometer and fixed his eyes on the small red fixation point The brightness of the test field was set initially at a sub threshold level and was exposed by means of a camera shutter for intervals of 1/50th second The intensity, altered by means of a density wedge, was raised by a small amount between each flash until the subject reported that he was aware of the light The brightness corresponding to the reading on the density wedge when the subject was just aware of the flash was taken as the threshold Readings were repeated until the operator was satisfie that a true threshold had been recorded The intensity of light thus seen was expresse in log/μmL The threshold of different individuals in good health may vary by : much as 0 5 log/μmL and is dependent on age and other factors The day to day range of variation of a single individual may be as great as 0 25 log/μmL A single value of a threshold alone is not a reliable criterion of vitamin A deficiency, but if it is abnormally high such deficiency is a possible cause In an ideal investigation, each subject would receive a therapeutic dose of vitamin A but this was impracticable in these surveys where a large number of subjects were examined instead only those subjects who had high thresholds were given vitamin A and retested

2 *Colour vision*

Colour vision tests (Ishihara) were done on all the subjects on whom dark adaptation retests were done in Leiden

3 *Endurance test*

Certain school medical officers in England have used as a test for nutrition the time for which a child can hang by the arms from a horizontal bar Although the premise that this endurance test had any necessary connection with nutriture was not accepted in any way the test was applied to four groups of children The children hung singly from a bar with the feet a few inches from the ground Other children watched but encouragement or jeering was not allowed

*Biochemical*

1 *Purpose*

The specific purposes of the biochemical work constituted a part of the main purpose of the survey as a whole, i e to present a picture of the nutriture of North West Holland as soon as possible after the liberation

They were

1 To supplement and assist the interpretation of the clinical results and to compare figures from groups differentiated by particular clinical signs or symptoms

2 To supplement the dietary findings and to compare figures from groups differentiated by intake of particular nutrients

3 To compare the figures from various groups of the population differentiated by age sex social class locality etc

4 To obtain figures for objective comparison with figures of other surveys

5 To record figures particularly relevant to deficiency disease and its cure

6 To help in assessing the effects of special therapy in suspected or diagnosed deficiency disease

## 2 *Team*

The main bulk of the estimations was done by full time laboratory workers from the Centraal Instituut voor Voedingsonderzoek, Utrecht (CIVO) The following took part A J Bos, H G Buyze, A Emmerik C G Engel, H C Grosjean, J T Heins T F Hendriks T Hidens, N F Jansen, J H van der Kamer, B B Lloyd, A Poelenjee H M Sinclair K B Taylor, F C de Vos, A M de Vries, R Wansink

## 3 *Equipment*

The Oxford Survey Team was equipped with two mobile laboratories which were independent of fixed external sources of heating, power, light and water They carried apparatus and chemicals for about 300 simultaneous estimations of each of the more important nutritional factors and for certain bacteriological tests, with a reserve stock of chemicals of 1500 of each estimation The available laboratory space was enough for about six workers it was hoped when the mobile laboratories were first planned that larger laboratories could be set up in permanent buildings and that equipment could be transferred to these

The mobile laboratories were fitted with oil heated ovens, refrigerators, incubators and autoclaves, and with stills fitted both for oil and electric heating, Gas from main supplies was not of course available Electric ovens refrigerators incubators and extra centrifuges were kindly lent to the survey by Medische Chemie, Praeventieve Geneeskunde and Interne Geneeskunde, Leiden, and by CIVO, Utrecht CIVO also provided an additional balance a tintometer, a Zeiss stufenphotometer and a Cohen fluorimeter The last three supplemented the Evelyn photoelectric colorimeter, Coleman spectrophotometer and Coleman photofluorometer from the mobile laboratories During the course of the work estimations of protein, by the gravimetric method and of cystine were done for these no initial provision had been made and most of the necessary apparatus was provided by CIVO

## 4 *Methods*

The types of samples examined were

### Blood

(Venepunctures were done with a minimum of stasis the subject was seated and was previously ambulatory except in the special case of patients in bed )

*a* Venepuncture oxalated with Heller and Paul s mixture Volume 4 to 20 ml

*b* Venepuncture blood allowed to clot for serum Volume 5 to 20 ml

*c* Venepuncture blood preserved with Long s fluoride citrate cetavlon mixture for pyruvate and glucose estimations Volume 1,5 ml

*d* Finger puncture blood collected into two capillary tubes, one for immediate measurement of whole blood density and one for measurement of serum density after clotting

### Urine

*a* Single samples for qualitative analysis no preservative

*b* Groups of three samples for quantitative excretion tests oralic or hydrochloric acid as preservative The urine was collected for a measured time before and

for the seven hours after ingestion of standard amounts per kg bodyweight of ascorbic acid, thiamine, nicotinamide and riboflavin

Milk

Drawn during feeding period with breast pump no preservative

Oedema fluid

Drawn by tissue puncture no preservative

Hair

Hair was cut from a small area of the scalp near the crown and sent back to England for amino acid and vitamin estimations no preservative

Samples were obtained from the following sources

1 The Oxford Survey Team in its routine surveys of Leiden and The Hague Samples were obtained from about one half of the adult subjects and capillary samples were obtained from most of the remainder and from the children For the later work, entailing a more complete blood examination, blood samples of types *a*, *b* and *c* were drawn at each venepuncture

2 The Oxford Survey Team in its special investigations in Leiden, The Hague and elsewhere Blood samples of types *a*, *b* and *c*, urine samples of types *a* and *b*, milk samples from nursing mothers and hair samples from certain groups of women were obtained

3 The U S Army team in its routine survey in Rotterdam A venepuncture sample, type *a*, was obtained from about one subject in twenty examined clinically

4 The R C A F team in its routine surveys in Amsterdam and Utrecht A venepuncture sample, type *a*, was obtained from about one subject in twenty clinically

5 The Netherlands Red Cross Feeding Teams of Dr Danby and Dr van der Spoel in the Academische Ziekenhuis, Leiden Venepuncture samples, types *a* and *b*, were obtained from incoming and outgoing patients On these samples Dr Dekker and his staff did general biochemical and mineral analysis and the Survey Team did its routine nutritional analyses

6 Special samples of serum and oedema fluid came from cases of famine oedema or other deficiency diseases in the care of various doctors in Western Netherlands

The estamination done are listed in table 23, with names of authors of the methods and the samples analysed The methods were selected for reliability, speed and convenience, and were in the main those used as routine methods by the Oxford Nutrition Survey during the previous four years

As a routine ,plasma protein, haemoglobin, whole blood ascorbic acid, plasma vitamin A and plasma carotenoid estamitions were done on all samples as the work progressed albumin and total protein on serum or plasma by the biuret method, haematocrit by Wintrobe's method, phosphatase activity, pyruvic acid' and glucose were estimated on the majority of samples in addition The other estimations in table 1 were done on samples of special interest from hospital patients or selected groups of subjects

TABLE 23

| Factor or Substance Estimated | Method | Authors of relevant publications | Date | * Medium Examined |
|---|---|---|---|---|
| Haemoglobin | Densitometric | Jacobsen & Linderstrom Lang | 1940 | B |
| | | Phillips, Van Slyke et al | 1945 | |
| Haematocrit | Centrifuge | Wintrobe | 1933 | B |
| Total protein | Densitometric | Jacobsen & Linderstrom Lang | 1940 | S, P, F |
| | | Phillips, Van Slyke et al | 1945 | |
| | Micro Kjeldahl | Markham | 1942 | S, P, F |
| | | Chibnall | 1943 | S, P, F |
| | Biuret | Kingsley | 1942 | S, P, F, M |
| | Gravimetric | Robinson & Hogden | 1941 | S, P, F |
| Albumin | Micro Kjeldahl | Markham | 1942 | S, P, F |
| | | Chibnall | 1943 | |
| | | Campbell and Hanna | 1938 | |
| | Biuret | Kingsley | 1942 | S, P, F |
| | | *Campbell and Hanna* | 1938 | |
| Non protein Nitrogen | Micro Kjeldahl | Markham | 1942 | S, P, F |
| | | Chibnall | 1943 | S, P, F |
| Cystine | Colorimetric | Kassell and Brand | 1938 | S, P |
| Vitamin A | Carr Price | Kimble | 1939 | S, P, F |
| Carotene | Colorimetric | Kimble | 1939 | S, P, F |
| Vitamin E | Colorimetric | Emmerie | 1942 | P |
| Phosphatase | Colorimetric | King et al | 1942 | S, P |
| Pyruvic Acid | Hydrazone | Long | 1944 | B |
| | | Friedemann & Haugen | 1943 | B |
| Glucose | Folin Wu | Harrison | 1937 | B |
| Ascorbic acid | Hydrazone | Roe & Kuether | 1943 | B, S, F, M |
| Riboflavin | Fluorimetric | Johnson | 1945 | U |
| Thiamine | Thiochrome | Johnson | 1945 | U |
| Factor F2 | Fluorimetric | Johnson | 1945 | U |
| Albumin | Qualitative | Cole | 1938 | U |
| Glucose | Benedict | Cole | 1938 | U |
| Ketone Bodies | Rothera | Cole | 1938 | U |

* Under Medium Examined
B = Whole Blood   M = Milk   F = Oedema Fluid
P = Plasma   S = Serum   U = Urine

From time to time there were flown back to England large numbers of samples of whole blood for estimations of niacin and riboflavin and of serum for estimation of calcium and other minerals.

Some of the estimations such as haemoglobin and erythrocyte and protein by four different methods provided reciprocal checks. A more detailed account of the comparisons between various protein methods which were undertaken will be given later.

For two of the most important estimations of vitamin A and of ascorbic acid, *parallel estimations on the same series of samples were done by the routine survey* methods and by the methods used at CIVO. This checking of methods was undertaken largely on the initiative of Dr van Eekelen. The methods for Vitamine A agreed well but the agreement for ascorbic acid was disappointing on two different occa-

sions, with two different sets of workers the routine method gave results which were about 60 % of those given by the indophenol method of EMMERIE and VAN EEKEN (1937). Part of the discrepancy was shown to be due to divergant systematic errors in both methods, but correction for these left the results by the routine method at about two thirds of those of the indophenol method. Subsequent experiments indicated that there was error in the routine analyses probably due to inadequate precipitation of protein, and after investigation it was decided that all notebook results had to be multiplied by a factor of 1,5. This decrepancy was due to the conditions under which the estimations were done in the Netherlands, in Oxford the hydrazine method had been repeatedly compared with the indophenol and the former found to be more reliable.

## *Miscellaneous*

### 1. *Height, sitting height, weight*

Height, sitting height and body-weight were measured on nearly all subjects.

The height was measured to the nearest half centimetre, the subject standing without shoes againts a vertical scale.

The sitting height was measured with the subject sitting upright on a stool of known height against a vertical scale.

The body weight was measured to the nearest 0,1 kg on subjects wearing normal indoor clothing without shoes, males being without jackets.

### 2. *Capillary fragility*

It has been suggested that there is a correlation, either negative or positive, between capillary fragility and blood ascorbic acid levels.

On certain groups of subjects, including children and those showing famine oedema or signs suggesting scurvy, capillary fragility was measured by counting the petechiae in a circle of skin 1 sq in. in area on the front of the forearm before and after subjection for one minute to a pressure 200 mg of mercury below that of the atmosphere.

### 3. *X ray photography*

A portable X ray apparatus (Watson High Power Type MX 2) was included in the equipment for obtaining information on bone maturation in Dutch children and bone changes shown by the people whose calcium intake had probably been very low. The arrangement made was that photographs of hands and wrists were to be done in Holland and sent back to Oxford where they were to be processed. For estimation of bone density an aluminium step wedge formerly used by Dr WINGATE TODD was included in the photographs. The Dennis Mobile laboratory had been originally designed for radiological surveys, the built in generator with a special voltage stabiliser had been retained and supplied the power for most of the work.

It was found impracticable to use the X ray apparatus before 12 June, when families selected from those attending the last clinic in the Hague were photographed.

On 28 June subjects in the Hague were recalled whose earlier clinical examination had suggesteth dat an X ray investigation was desirable. The numbers of these subjects are entered in appendix 32 table 42 under their original clinics.

*Clinical*

An adequate statement of the clinical findings and their interpretation must be withheld until a Final Report is prepared, because there has not yet been time fully to analyse the large mass of data collected in these surveys owing to the team being transferred to Germany.

In the six clinics held in Leiden, 1050 subjects were examined clinically. The age and sex distributions are shown on app. 22 table 2. In the eight clinics held in The Hague, 1488 subjects were examined clinically, distributed as shown in the table. The main signs and symptoms encountered were obvious weight loss and its sequelae (particularly amongst the adults), diarrhoea and a history of severe diarrhoea in the preceding winter, nycturia, amenorrhoea or delayed menarche, nutritional oedema, petechiae, denudation of the filiform papillae of the tongue (particularly in the older age groups), pallor and folliculosis (particularly in the age group 7—14 years). Gingivitis was uncommon, and blepharitis, corneal vascularisation and muscle tenderness were seldom seen.

In these clinics, nutritional oedema was found only in adults. An analysis of the figures is given in appendix 32 table 43. Ignoring social classes, 14 % of all the adults examined in Leiden, and 20 % of those examined in The Hague, were found to have nutritional oedema. If attention is confined to males and females of 60 or over, the incidence becomes 40 % in Leiden and 50 % in The Hague.

*Dietary*

In appendix 32 a report on the food position in Leiden and The Hague during the winter of 1944—1945 and spring 1945 is given.

*Functional*

*Dark adaptation*

The mean values for the different age groups in the three social classes for Leiden and The Hague are given in Table 31. In table 32 is given a summary of the classification of all estimations into the three somewhat arbitrary groups of "Normal", "Abnormal" and "Extreme".

*Effect of age, sex and social classes.* It is generally accepted that the visual threshold of the dark adapted eye increase with age, and the results from Leiden and The Hague support this. In all social classes and sex groups where there were suficient figures, the means in the age groups 45 and upwards higher than those in the age group 20—44. In Leiden females, low classes, in The Hague males, middle class, and in The Hague females, low class, the age group 20—44 gave greater values than the age groups 15—19 and below. There were no differences between the sexes which have therefore been combined in the table, and in Leiden there were no marked differences between the social classes. In The Hague, in the age group 45 and upwards both male and female, the mean values for visual thresholds were greater in the low than in the middle and high classes.

*Incidence of deficiency of vitamin A.* High visual threshold can be proved to be related to vitamin A deficiency only when they are significantly reduced by controlled vitamin A therapy. It was possible to give such therapy to selected persons only

*Leiden* 37 subjects were selected on the basis of abnormal values from those routinely examined, and were retested about three weeks after the initial examination 21 were given 100 000 I U of vitamin A by mouth and again retested with the other 16, after four days The mean values at the three dates for the test and control groups are given in the table below, the values being in log micro millilamberts

| | 24—30 May | 15 June | 19 June |
|---|---|---|---|
| Control Subjects (16) | 2 431 | 2 303 | 2 111 |
| Test Subjects (21) | 2 330 | 2 277 | 2 370 |

The mean values show that the vitamin A therapy had no effect on the high visual thresholds in the test group In contrast the control group showed a decrease in mean threshold between the first and second test and between the second and third tests The first second improvement is perhaps attributable to the improvement in the vitamin A content of the ration, hence the controls showed a vitamin A labile threshold which improved further on the increased ration between the second and third tests The test group however showed no marked lowering in mean threshold value between the first and second tests, when an increase in rationed food containing vitamin A did occur hence it may possibly be inferred that the test groups mean threshold was vitamin A stable, and did not therefore decrease after heavy ingestion of vitamin A In this connection, as mentioned above, the subjects were selected because they had been found to have poor dark adaptation when routinely tested at the clinics in the selection the cause of the defect was not considered Therefore many old subjects were selected, and it chanced that 36 % of the test subjects and 20 % of the control subjects were in the age group of 45 years and upwards A large proportion of the old subjects had eye lesions such as cataract and such defects were noted in the ophtalmological examination The effect of such lesions upon the results will be analysed in the final report

Examination of the individual figures shows that one control subject and two test subjects showed significant lowerings of visual threshold between the second and third tests, i e more than 0,3 log/μmL

*The Hague* In the Hague 30 subjects were selected for retest All were given 220 000 I U of vitamin A by mouth in four separate doses over a period of three days after the first retest The mean thresholds were, in log/μmL

| | 4—12 June | 27 June | 30 June |
|---|---|---|---|
| Males (8) | 2 269 | 2 106 | 1 861 |
| Females (22) | 2,686 | 2 025 | 1 825 |
| All (30) | 2 575 | 2 047 | 1 834 |

In these groups the proportion of the people in the age group 45 and upwards was much smaller than in Leiden There were significant changes between first and second tests and between second and third tests and there were eight subjects in which the visual threshold decreased by more than 0 3 log μmL after vitamin A therapy, and then ten other subjects whose visual threshold decreased by this amount between first and second tests with no special therapy apart from the increased ration The change after vitamin A therapy in mean visual threshold

for the eleven women in the age group 20—44, had been examined statistically. The mean values before and after therapy were 2,025 and 1,769 log/μmL, the difference is significant (t = 3)

In the final report a discussion of the relationship between corresponding visual thresholds, eye lesions discovered by the ophthalmological examination, plasma vitamin A levels, and dietary vitamin A in these subjects will be given At this stage it seems safe to say that certain subjects of the survey in The Hague were deficient in vitamin A

*Colour vision*

On all subjects on whom dark adaptation retests were done, Ishihara tests were done There were no marked abnormalities, two males being red green colour-blind

*Biochemical*

*Tabulation of results*

The Oxford Nutrition Survey routinely employs two forms for the tabulation of data, and these [illegible]
of biochemical dat[illegible]
of each estimation [illegible]
and gives relevant statistical data such as means and deviations from the means The form for the estimation of any particular factor therefore facilitates (i) the computation of the significance of differences between the means of groups, differentiated for example by nationality or social class, and (ii) the grouping of the estimations into three categories, conveniently designated "Normal", "Abnormal" and "Extreme" It must be emphasized that these somewhat arbitrary categories, which are listed in Appendix 32, table 9, are used because they are convenient in handling the result, and they do not necessarily imply nutritional deficiency or impaired health

Appendix 32, table 10 to 21, give in summary form the total results of estimations done on samples from subjects from Leiden and The Hague These tables also give the numbers of estimations done and the mean values obtained from groups of subjects, from Leiden and The Hague separately, differentiated by sex, age and social class Where the difference between the results in such groups is of sufficient interest to justify this, the numbers and percentages of estimations for each city as a whole falling into the categories of "Normal", "Abnormal" and "Extreme" are given in Appendix 32 table 31

*Discussion of results*

A full discussion of the biochemical results entails exhaustive computation of significant differences between groups of estimations differentiated not only by sex, age and social class, but also by clinical condition and dietary intake In addition, for the discussion of some nutrients, correlations between variables of which one or both may be biochemical, must be computed this entails the extensive use of punched cards and the plotting of scatter diagrams

The appendix gives the tables, setting out detailed results that are summarised in the following paragraphs

*Social class*

1 *Haemoglobin* In Leiden and The Hague there were no marked differences between the classes except that in The Hague males in the 20 to 44 age group gave a greater mean value in the high than in the middle and low classes (Appendix 32, table 10)

2 *Erythrocrit* The results from Leiden are too few to permit of comment. In The Hague there were no marked differences between classes

3 *Leucocrit* No differences between social classes were found

4 *Total serum and plasma protein* (densitometric and biuret methods) No differences between social classes were found

5 *Serum albumin* Results in The Hague showed no differences between the classes

6 *Vitamin A* In Leiden, both in males and females, in age groups from 20 upwards, mean values from the middle class were greater than those from the low class In The Hague no marked differences were found (Appendix 32, table 17)

7 *Carotenoids* In Leiden there were no marked differences In The Hague the age groups from 20 upwards (particularly in the case of females) gave smaller mean values in the low than in the middle and high classes (Appendix 32, table 18)

8 *Phosphatase* No differences between social classes were found

9 *"Pyruvic acid"* In age groups from 20 upwards, mean values in the low class were greater than in the middle class in both males and females

10 *Ascorbic acid* There was a noticeable tendency for the middle social class, of either sex, to have higher means than the low class (Appendix 32, table 21)

11 *Summary* The subdivision of results by social class thus shows for several estimations, that the mean values were generally nearer the abnormal in the low class than in the middle and high class The mean haemoglobin values for the adult females in Leiden are an exception, the high class giving the smallest mean It is perhaps noteworthy that no differences between social classes are shown by the mean values for total protein in serum and plasma Nearly all the differences between means from different social classes are small

*Sex*

1 *Haemoglobin* For haemoglobin and erythrocrit, different standards of normality for the two sexes have been adopted Consequently a direct comparison between mean values from the two sexes is profitless Some comparison has been made from the classification of results in the three categories "Normal", "Abnormal" and "Extreme"

In Leiden, on differential standards, in all groups, social and age the sexes gave approximately similar values, with one exception in the middle and low classes, age group 45 and upwards, females gave greater relative values than males

In The Hague the picture was less homogeneous On differential standards females gave greater relative values than males in the age group 15 to 19, in the middle and low classes, in the age group 20 to 44 in the middle class, and in the age group 45 and upwarts in the high, middle and low classes No differences were found in the 20 to 44 age group in the high and low classes

2 *Erythrocrit* As stated above under haemoglobin, differential standards of normality have been adopted for erythrocrit values from the two sexes Few erythrocrit values were obtained from Leiden, in the Hague females gave greater relative values in the age group 15 to 19 in the middle and low classes, in the age-group 20 to 44 in the middle class, and in the age group 45 upwards in the high, middle and low classes It is perhaps noteworthy that in no age or social class did males give greater *relative* values than females, on the selected differential standards A choice of different standards could have given a quite different picture

3 *Leucocrit, Total Serum and Plasma Protein* (densitometric and biuret methods), *Serum Albumin, Vitamin A, Carotenoids, Phosphatase, Pyruvic Acid*', *Ascorbic Acid* No marked differences between the sexes were found

4 *Summary* The differences between the sexes were thus negligible Any slight differences found, as in ascorbic acid and serum albumin in absolute mean values, and haemoglobin and erythrocrit in relative values, were in favour of the females The relative differences based on differential standards for haemoglobin and erythrocrit depend largely on the somewhat arbitrary choice of standards for 'Normal', 'Abnormal' and 'Extreme'

*Age*

1 *Haemoglobin a Males* In Leiden and The Hague, the highest mean values were found in the 20 to 44 age group in all three classes In the same classes the age groups 45 and upwards gave the lowest values on the differential age standards adopted for haemoglobin

*b Females* In Leiden and The Hague and in all three social classes, there were no marked differences between mean values of the age groups similarly classifications on the differential standards showed little difference between the age groups

2 *Erythrocrit* The results in Leiden were too few to permit of comment For males in The Hague in all three social classes, the ascending order of mean values corresponded to the following order of age groups 60 and upwards, 45—59, 15—19, 20—44 Differential classification showed in the high and low classes that the 20—44 age group had the greatest relative as well as absolute values

In females in The Hague there were no marked differences between the age-groups

3 *Leucocrit* There were no differences between the age groups

4 *Total serum and plasma protein* (densitometric and biuret methods) Few figures are available for the young age groups, but in general the mean values from groups 0—1 2—6 are lower than those from groups 7—14, 15—19, 20—44 and 45 and upwards The literature on the subject indicates that there is a physiological increase in mean total protein levels with age in very young children In all social classes, in Leiden and The Hague and in both sexes, there were no marked differences between the means in the age groups 15—19, 20—44 and 45 and upwards

5 *Serum albumin* In males of the low and middle classes mean values in adults decreased as age increased A similar effect was noted in adult females of the low class Sexes and classes have been combined in the table

6 *Vitamin A* There were no differences between the age groups

7 *Carotenoids* In Leiden the males and females of the middle class, and in all classes and both sexes in The Hague except females of the middle class, the age group 45 and upwards gave greater values than the age group 20—44

8 *Phosphatase* In The Hague males and females of the middle class, mean values in the age group 45 and upwards were higher than those in the age group 20—44

9 *"Pyruvic acid"* There were no differences between the age groups

10 *Ascorbic acid* There were no marked differences between the age groups

11 *Summary* In general the age grouping showed that for the results from most of the estimations the group 45 and upwards was more abnormal than the 20—44 group Apart from the estimations where there were no marked age differences, the reversal of this tendency was found in the carotenoid results The mechanism of the conversion of carotenoids to vitamin A is not clearly known, it is possible that it is somewhat impaired in later life, and that a raised plasma carotene level results from such impairment

*Discussion*

The summaries in Appendix 32, table 31, in which the results are grouped as "Normal", "Abnormal" and "Extreme" show that haemoglobin values are more abnormal, *in all groups of the population, than values from any other estimations* indeed the majority of these latter values are "Normal", whereas of all haemoglobin values 58 % are "Normal", 34 % are "Abnormal" and 8 % are "Extreme"

The nutritional significance of these lowered haemoglobin values in liberated Western Netherlands is not quite clear They do appear to demonstrate conclusively the desirability of haemoglobin estimations in general nutritional surveys

*Capillary fragility*

Measurements of capillary fragility were made on various groups of subjects The results for these groups have been analysed by sex and age, and classified as "Normal", "Abnormal" and "Extreme" (Appendix 32, table 35)

Except for the male children of the age group 7—14 attending Prof GORTER's clinic (see below), of whose values only 53 % were normal, the subjects under 45 give smaller mean values than do those of 45 and upwards

The younger people in Holland gave results almost identical with those found in England in 1941—1943

*X ray photography*

354 radiographs of the hands and wrists of people ranging from early childhood to late adult life have so far been examined The distribution in the various groups is given in Appendix 32, table 3 The findings have not yet been submitted to detailed statistical analysis but the following report is included subject to correction

1 Among the children, there was only one case of rickets and none of scurvy.

2 Almost all the children were under developed The range of skeletal immaturity was certainly greater than has been seen among groups of poor children in Great Britain, or among the Dutch children from Southern Holland examined in England by the Oxford Nutrition Survey

3 The majority of the middle aged and the very old people showed marked decalcification of their bones, but no spontaneous fractures were seen

When the statistical analysis has been made it will be possible to make a definite statement on point 2, for details are available from other groups of children for the purpose of comparison and check

No definite statement on point 3 can be made until other people of these age groups have been examined but it is possible to say that the incidence and severity of decalcification among the older people is greater than would have been expected from clinical experience

*Measurement of subcutaneous tissue*

The results on general survey subjects and some special groups are summarised in Appendix 32, table 36 In subjects of 15 and upwards the mean values for females were about 1 5 times as great as those for males In children, the sex difference was less marked The lowest mean values were found in the oldest age group

Further analysis of these figures which are unchecked and a comparison with values from groups outside the Netherlands will be given in a final report

## *Special groups of subjects*

In a famine such as occurred in Holland in which most of the available food was rationed at a very low level those subjects who were unable to obtain supplementary food or who had special physiological requirements were likely to suffer most The general surveys confirmed that old persons and children fared particularly badly and it was probably that the stress groups of women during pregnancy or lactation would be similarly affected Special attention was therefore paid to the examination of these groups and of subjects in institutions, such as mental hospitals

*a Old people*

Old people represented a particularly vulnerable class because they were unable to forage for themselves and unless they obtained food in the black market, had to subsist upon the official ration alone This was inadequate for existence It has already been mentioned that the main incidence of nutritional oedema occurred in the highest age group It was therefore particularly important to study old people and this was done by visiting various institutions for the old and by a detailed study of 30 patients in a Home for the aged of the Dutch Reformed Church This Home, for men over the age of 60 years had received only the official ration except for some vegetables grown in the garden

At the first visit it was noticed that about 30 of the 54 patients had nutritional oedema and it was stated that since the beginning of the year most of the patients had been grossly underfed the normal death rate for the Home was about 20 persons a year, but during the past winter it had nearly doubled

A further visit was paid to the Home on 15 June, and 31 males were examined in detail Blood samples were taken and fully analysed, and urinary excretion tests were performed for ascorbic acid, thiamine, niacin and riboflavin

Appendix 32 table 32a gives mean values and numbers of biochemical estimations on male subjects of 45 and over seen I at a Leiden Poliklinick, which they were attending for special food because of diagnosed undernourishment

II at the Old People's Home in Leiden, and III at The Hague at the general survey clinics Appendix 32, tables 22—29 give the urinary results

There appear to be no marked differences in blood analyses between the two age groups considered The mean ascorbic acid value for the 21 subjects of 60 and over in the Old People's Home was the smallest in the table, and in general the 60 and over groups gave smaller mean ascorbic acid values than the 45—59 group from the Old People's Home The mean "pyruvic acid" value in the call for comment are those for carotenoids, which were high, and for vitamin A which were low, in the Leiden Poliklimiek subjects It is possible that the conversion of carotenoids to vitamin A was diminished in these subjects It will be remembered that similar results were found in the age group 45 and upwards in the Leiden general survey

The biochemical results thus do not show marked differences between the middle aged and old male adults, nor do the male dwellers in the Old People's Home show mean values different from those found in the same age group of the male subjects of the general survey

b *Pregnant and lactating women*

Women during pregnancy and lactation form a particularly important stress group It has been noted earlier that the rations particularly of pregnant women, were grossly inadequate Therefore two studies were undertaken A visit was made to the Maternity Ward of St Elisabeth's Ziekenhuis where 23 women were examined, 2 being pregnant and 21 lactating, X ray photographs were also taken because of the importance of calcium for this group, and 22 blood samples were analysed Secondly, 21 women attending a postnatal clinic were similarly examined by the Survey Team In these groups samples of milk were obtained, some analyses being done locally by the team and other by Dr Kon at the National Institute for Research in Dairying, Reading

Appendix 32 table 33 summarises the biochemical results on blood samples, the number of results on milk is too few for comment at this stage, when no correlations for individual estimations have been calculated For purposes of comparison mean values from women of the age group 20—44 in the middle class examined at the general clinics in Leiden and The Hague are given with the values from lactating women of the same age group the results from one lactating woman over 45 and the two pregnant women are not included

The women in the Maternity Ward (in bed) had been lactating for about one week, and had smaller mean values of haemoglobin, erythrocrit, serum protein and serum albumin It is known that mean serum protein concentrations are lower in subjects lying in bed than in those who are ambulatory, and the differences in mean protein values may be explained by this The women in the Maternity Ward also had greater mean levels of phosphatase activity, greater mean 'pyruvic acid" values and, in contrast, greater mean values of vitamin A and carotenoids The women attending the post natal clinic had been lactating on the average for about seventy days and had mean levels differing very little from those of The Hague and Leiden women except perhaps for their greater mean 'pyruvic acid' level Ascorbic acid levels were similar in the four groups

c *Children*

These constitute the third special group who where particularly liable to fare badly in times of famine As mentioned earlier the diet of children over 1 year

of age was relatively better than that of infants adolescents or adults Despite this there were three reasons why particular attention should be paid to children First there were excellent statistics of height and weight which had been collected by Dr STRENG in The Hague before the war Secondly the Oxford Nutrition Survey had already obtained such statistics upon children evacuated from the southern part of the Netherlands to England Thirdly the nutrition of children is especially important because of the permanent damage that may result from malnutrition during childhood

Apart from the children seen in the normal clinics in Leiden and The Hague, six groups were specially examined

1 *Gorter children* Many children were attending the clinic of Prof GORTER at the Rijks Academische Ziekenhuis in Leiden to be examined before being selected for a stay in England or Switserland The opportunity was taken in consultation with Prof GORTER of examining 173 of these children on five different days

2 *Schoolboys* In Leiden 51 boys were examined on consecutive days from secondary schools of different social class 27 in one group and 24 in the other A very detailed examination was made including a clinical examination medical and diet histories estimations on a venous blood sample urinary excretion tests, photography, X rays of the hand and wrist dark adaptation and endurance and capillary fragility tests Height weight and sitting height were recorded as usual

3 *Gaillard children* Dr GAILLARD Director of Public Health in Leiden selected 51 children from those chosen for the receipt of extra food because of undernourishment These children were examined in the clinic of the Survey

4 *Streng children* In a similar way Dr STRENG selected 59 children in The Hague who were undernourished and kindly arranged for their examination in his clinic

5 *Hague III children* At the lunch interval of the third clinic at The Hague a number of children happened to attend the building in which the clinic was being held to receive extra food provided by the I K B The opportunity was taken of examining 19 of these children who had been selected for supplementary rations because of undernourishment

6 *Jonxis children* Through the enterprise of Dr JONXIS a large number of starving infants and children had been gathered together in improvised wards in Rotterdam 67 of these children were examined in these wards This examination included height weight clinical examination X rays of the hand and wrist and the analysis of blood samples

The results of the examinations of all the above children and of the children attending the main clinics in Leiden and The Hague may most conveniently be considered together

*Heights and weights*

The heights and weights of 636 female and 648 male children between the ages of a few months and 16 years were recorded The results have been analysed in terms of sex districts and three social classes for each year of age The mean heights and weights and numbers of children within the various sub groups are shown in Appendix 32 tables 37 to 40 It should be noticed that the age group 4 includes all children from 4 years 0 months to 4 years 11 months and hence the

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figures are compared with The Hague standards (1934) for the corresponding mid year figures i e in this case 4 years 6 months

*Results*

Most of the means fall below the corresponding norms for age but the numbers within the sub groups are too small to permit of an avaluation of the statistical significance of the differences

An analysis by districts of the results for Leiden and The Hague calculated separately gave differences that were in general negligible The slightly better results obtained in the clinics in The Hague can be accounted for by the greater proportion of children of low social class attending the Leiden clinics It was therefore permissible to combine the two retaining age sex and social class in the analysis

It will be noticed that in general the results for both height and weight but more specially for height follow the social classification very closely in boys and girls *The numbers in the high social class are very small but they tend to be the* tallest and heaviest children with children in the low social class the smallest

gave results which were worse than those of the low social class of The Hague and Leiden

*General*

When all economic groups are combined the mean heights are slightly lower than the norms for The Hague for all ages of boys Weights follow a similar trend with the minor exception of the 11 year group

Appendix 32 tables 37 and 39 indicate the number of boys within each district who reached the standards of The Hague in height or weight Only in the high social class attending clinics *in The Hague and Leiden did more than 50 % attain* the standards In the Gaillard and Jonxis clinics practically no children reached the mean height or weight for their age

*Endurance test*

Two groups of Leiden school boys were tested one group from a poor school and another from a better class school the third group consisted of Leiden children selected at random during *an examination conducted by Prof* GORTER *for children* who were being evacuated to England or Switserland the fourth group was selected by Dr GAILLARD of Public Health for Leiden from poor children in receipt of extra food because of undernourishment

Appendix 32 table 41 summarises the results A comparison of the times with those given by MILLIGAN for English children in 1940 (E H M MILLIGAN *Annual Report of the School Medical Officer for Glossop* 1940) shows that the Dutch children endured this monotonous pastime for only *half the time recorded for the English* children and the reader can draw what conclusions he wishes

## *Biochemical results*

Appendix 32 table 34 gives mean values and numbers for certain estimations done on six special groups of male children of the age group 7—14 Values from

males of the same age group and of the low social class attending clinics in Leiden and The Hague are given for purposes of comparison It should be mentioned that the ages of the Leiden schoolboys fall in the upper part of the age group 7—14 whereas those of the other special groups in the main fall in the lower part Values for female children have been omitted from the table as they do not differ appreciably from tho e of the males The numbers in the other age groups are too few for comment at this tage

1 *Haen oglobin*

The arbitrary low limit for Normal haemoglobin values for this age group is 12 0 g/100 ml The mean values from Gaillard and Streng children groups selected as being malnourished fell below this value The mean value from the 46 Gorter children was close to it The greatest mean was that from the Leiden schoolboys who as mentioned above were the oldest group

2 *Serum protein*

The arbitrary low limit for Normal of 6 1 g per 100 ml was at least ten per cent less than the mean values from all the groups The mean value from The Hague children of the low class is fairly consistently smaller than the mean values from the other groups

3 *Phosphatase*

In the Leiden schoolboys the mean phosphatase value was 14 0 units per 100 ml serum This was considerably greater than the mean values for adults given in Section III and was presumably a physiological concomitant of growth

The full results of the detailed estimations on blood and urine from the Leiden schoolboys will be given in the final report The high mean values of 1 46 mg per 100 ml whole blood for pyruvic acid and 1 00 mg per 100 ml whole blood for ascorbic acid are noteworthy

*Dark-adaptation*

The mean values of the results are given in table 35 with the biochemical results The mean values were satisfactorily small as compared with the arbitrary lower limit of Abnormal 2 10 log/μmL

*Special problems*

*Pigmentation and depigmentation*

It has been known for many years that cachexia is often accompanied by pigmentation of the skin This pigmentation was obvious in many of the subjects seen in the Netherlands but there was no evidence that it was due to deficiency of niacin A curious special type of pigmentation was encountered on rare occasions a reddish brown discoloration of the nail developed and when the nutritional situation improved a nail of normal colour was formed which contrasted markedly with the pigmented nail

Another interesting pigmentary change that was encountered consisted of pigmentation of the skin particularly of the face and hands followed by marked depigmentation an appearance of vitiligo combined with sunburn was produced

Photographs were taken of this condition and an attempt was made to treat it with pantothenic acid, following the work on kwashiorkor in East Africa. One of the most characteristic features of this condition, as of kwashiorkor, was depigmentation of the skin around the anus.

*Oedema*

One of the most outstanding clinical findings was the high incidence of nutritional oedema. A cursory examination of the results obtained by the Survey Team revealed no correlation between analyses of serum for total protein or albumin and the incidence of oedema; therefore a few further studies were conducted towards the end of the work when, however, cases of oedema were becoming scarce. These studies followed two main lines: first, the detailed examination of samples of serum and the simultaneous analysis of oedema fluid; secondly, the effect of therapy upon cases of oedema.

The therapeutic trial consisted of treating certain cases of supposed nutritional oedema with one of the following factors: methionine, cystine, lysine (5 g daily by mouth), thiamine hydrochloride (5 mg intravenously), calcium gluconate (10 ml of a 20 % solution intravenously). The subjects were examined in detail at frequent intervals, these examinations including a record of weight without clothes and with the bladder empty. The full details will be given in a final report; there was no evidence that the forms of therapy employed had any markedly beneficial effect upon the oedema, although results with methionine and cystine were sufficiently encouraging to warrant further investigation.

Appendix 32b gives a summary of results of estimations on samples of blood and oedema fluid from a miscellaneous group of patients with nutritional oedema in Western Netherlands; most of the patients were ambulatory, and were past middle age. The results are not given separately for males and females. The lower limits of "Normal" values in adult women for haemoglobin and erythrocrit are greater than the values given by the oedema patients, male and female together. The other mean blood values except possible for serum albumin are not remarkable and are similar to those found in the general surveys in Leiden and The Hague. The serum albumin mean value is rather smaller than mean values from the general survey. The mean value for protein in oedema fluid was about 1 g per 100 ml. About half of this was albumin; precautions were taken to prevent pressure and evaporation, but the cases were of long standing.

We do not wish to discuss here in detail the aetiology of the nutritional oedema that was so prevalent. It was certainly not caused by deficiency of thiamine, nor was it associated with abnormally low values for total protein or albumin in serum as was shown by our very detailed analyses by four different methods (three for albumin). The analyses of protein in the fluid upon which however we place no very great reliance because the oedema was not developing tend to show that the permeability of capillaries was increased (unless concentration of the fluid in the tissues had occurred). We were very impressed by the frequency with which increased salt intake caused oedema and a diet relatively deficient in salt was accompanied by inanition without oedema, there seemed to be an inability of the kidney to excrete salt at the normal rate but it was not possible to get objective proof of this — fortunately the nutritional situation rapidly improved and oedema became

very infrequent The non protein nitrogen concentration in oedema fluid was similar to that in serum

*Discussion*

Discussion of the results is most conveniently given under the heading of the main nutrients included in the normal diet Summaries of some of these figures are given in the tables included in this report and a main summary of the more important biochemical results obtained in Leiden and The Hague is given in Appendix 32, table 31

*Energy producing foods*

In the autumn of 1944 a sudden fall occurred in the caloric value of the diet which dropped to no more than 50 % of the theoretical allowance for adults Throughout the winter the situation deteriorated further particularly for adolescents in general the younger the child the less bad its ration Apart from the month of September when there was an issue of jam and sugar the main energy producing foods were potatoes bread and pulse Other foods occasionally available (such as vegetables sugar beet and tulip bulbs) were poor sources of energy but to some extent relieved the hunger Fat was particularly low After liberation the rapid increase in rations remedied the defects although the foods that were first available had a somewhat high content of fat for starving people and tended to cause sickness

Clinically this undernourishment was accompanied by marked loss of weight some persons losing almost all subcutaneous fat and a considerable portion of muscle In children growth was diminished and development delayed in girls this was accompanied by delayed menarche In women there was amenorrhoea although the precise cause of this was not ascertained although psychological factors played a part in some cases we believe the main cause was nutritional there was no evidence that ovulation was affected

No biochemical estimations give direct information on the past intake of energy producing foods Some estimations of blood glucose were done on selected groups of subjects and although no analysis of these has yet been made it seems that most values were normal The values of serum protein haemoglobin pyruvic acid and the two haematocrits may be indirectly related to caloric intake of these haemoglobin values were relatively most abnormal

*Protein*

For adults the total protein supplied by the food was about half the standard allowance since potatoes bread and pulse were the main foodstuffs during the winter the ingestion of animal protein was particularly low Famine oedema was encountered frequently in the highest age group but no direct evidence was obtained that this was caused by deficiency of protein it was certainly not caused by deficiency of thiamine and its aetiology will be discussed in the final report Because it has been shown that amino acid deficiency particularly of tryptophan causes corneal vascularisation in animals a large number of subjects including clinical cases of cachexia and famine oedema were examined with a slitlamp microscope almost no corneal vascularisation was found

Of all the analyses of total protein in serum and plasma from general survey subjects less than 2 % were Abnormal These levels in no way reflect the lowered

protein intake of the subjects during the preceding six months It is possible that results obtained during the worst period of deprivation would have been lower The mean value for serum protein from patients with oedema examined by the Survey Team was similar to the mean values found in the general survey Indirect information is perhaps given by haemoglobin results, especially when iron and ascorbic acid intakes have been moderately adequate as in the Netherlands during the period of deprivation, Appendix 32, table 31 shows that 38 % of all haemoglobin values were 'Abnormal' or 'Extreme" A considerable higher proportion of the oedema patients gave values in these two categories It should be emphasized that possible changes in blood volume are not being considered in this report in the discussion of the biochemical results

*Fat and fat soluble vitamins (other than vitamin D)*

After September 1944 fat was very low in the diet and many of the common sources of fat soluble vitamins were completely absent The consumption of vegetables was not sufficient to raise the carotenoid content of the diet to levels that would offset the lack of vitamin A Clinically, a high incidence of folliculosis was found and this may have been related to deficiency of fat (we do not believe it was related to deficiency of soap, the high standard of personal hygiene under very adverse conditions was extraordinary) there was no xerophthalmia no where there other eye changes that could be attributed to deficiency of vitamin A

Direct biochemical evidence is available for vitamin A and its possible precursor carotene, but no results give direct information of fat intake There is an indication that the vitamin A intake was rising during the early part of the Survey period since the main values from the first Leiden clinics were considerably lower than those of the later clinics of Leiden and The Hague The evidence from measurements of dark adaptation supports this the values tended to fall as the result of the increased ration after liberation, and in selected cases after intensive therapy with vitamin A there was therefore some evidence of deficiency of vitamin A in the population and this probably would have become severe had the diet remained for much longer at the low level it reached in April 1945, and the liver stores of vitamin A become further depleted

*Calcium, phosphorus and vitamin D*

Total calcium tended to be adequate for those age groups most in need in this nutrient since milk and skimmed milk were distributed to them For adolescents and adults, dietary calcium was low throughout the winter since milk and cheese were scarce The calculated values did not take into account the availability of calcium which may have been low when vegetables and pulse were its main source in the adult diets and the bread was of high extraction No clinical rickets was seen except in the lowest social class in The Hague where one infant had marked active rickets and a few children showed rachitic stigmata Certain subjects, particularly in institutions (such as a Convent), had clinical symptoms strongly suggestive of Milkman's disease X rays were taken of hands and wrists for maturation and bone density but have not yet been analysed for the latter

Phosphatase estimations were done on various groups of subjects About 80 % of the values were Normal slightly raised mean values being given for old people and (as is usual) for children The results of calcium estimations on serum samples

flown back to England have not yet been fully examined but appear to be normal as would be expected from the phosphatase values There was thus very little biochemical evidence for impairment of calcium phosphorus nutrition in the normal population

*Iron*

Iron appeared from the dietary investigation to have been adequate, the main sources being bread of high extraction, potatoes, pulse and other vegetables but the availability of iron in these foods has not been considered here

Clinically, pallor was frequently encountered Nearly 40 % of the haemoglobin values from the general surveys in Leiden and The Hague were either "Abnormal or' Extreme [illegible]
or 'Extreme' [illegible]
on biochemic [illegible]
use of non comparable standards of normality, the relationship between haemoglobin and erythrocrit is based on that given by PHILLIPS, VAN SLYKF et al (1945), namely that 100 ml of cells centrifuged under standard conditions contains 33 9 g of haemoglobin The oedema patients, as mentioned above, gave mean haemoglobin values consistently lower than those of other adult groups, male or female It seems probable that this is not a direct result of iron deficiency but a consequence of general malnutrition or deficiency of some other specific nutrient

*Vitamins of the B complex*

I *Thiamine* appeared to have been adequate throughout the winter in all age groups, since bread of high extraction and pulse were ingested, however, the caloric value of the food though low, came mainly from carbohydrate sources Clinically no evidence of deficiency of thiamine was found Blood "pyruvic acid' values, which express total hydrazone forming substances as 'pyruvic acid" and must be reduced by about 0 5 mg/100 ml for comparison with true pyruvic acid figures, were almost all normal

II *Niacin* was probably not present in the diet in adequate amounts and deficiency may have been enhanced by low amount of tryptophan in the diet Occasional clinical evidence of pellagra was seen although there were no frank cases in the general clinics The relation of diarrhoea which was frequently encountered, to deficiency of niacin will be discussed in a final report

III *Riboflavin*, supplied in the diet was low in the adolescent and adult groups during the winter since milk and animal protein were deficient The extra milk given to children provided them with adequate amounts No clinical cases of ariboflavinosis were seen and extremely little corneal vascularisation was encountered However, denudation of the filiform papillae of the tongue and also a mild form of cheilosis were frequently encountered No therapeutic trials were done upon these, and it has not yet been possible to analyse the incidence of these signs as correlated with the excretion tests for riboflavin It is possible that they were caused by deficiency of niacin or of riboflavin the colour of the tongue, as well as the presence of certain cases of pellagra encountered in hospitals and institutions suggested that deficiency of niacin rather than of riboflavin was the cause As

mentioned above, a curious pigmentation and depigmentation of the skin was found; and it was thought that it might have been due to deficiency of pantothenic acid; this was not like the changes that occur in pellagra.

*Ascorbic acid*

The calculated dietary content of ascorbic acid was high throughout the winter in all age-groups. However, the Netherlands dietary tables, in which allowances had been made for losses in cooking, seemed to contain higher values for ascorbic acid in foodstuffs than are customarily used in England; but as fuel was short the relatively large amounts of potatoes and vegetables were cooked for only a short time and it is probable that the intake of ascorbic acid was in fact adequate throughout the winter. Four persons in the general clinics were diagnosed on clinical grounds as having deficiency of ascorbic acid.

Appendix 32, table 31 shows that about half of the ascorbic acid values were "Normal", but these values must be accepted with caution in view of the technical difficulty encountered with the method. The choice of standards of normality for whole blood ascorbic acid values is largely arbitrary, as compared for example with haemoglobin values, and further work on ascorbic acid deficiency must be done before standards are satisfactorily established. The mean values for most of the groups examined were about 0,5 mg per 100 ml of whole blood. This compares favourable with mean values found in various groups in England during the war, and corresponds to a dietary intake of about 30 mg *per diem*, which is our arbitrary dietary allowance. The calculated ascorbic acid content of the diets of nearly all groups throughout the period of deprivation slightly exceeded this allowance.

## General conclusion

The general conclusion from a preliminary analysis of the results is that there was gross undernourishment and little evidence of specific clinical nutritional deficiency diseases But famine oedema was common, particularly in the higher age-groups in the general population. There was some deficiency of vitamin A and of niacin. Had the period of marked deprivation of food which occurred acutely, continued for much longer, clinical cases of specific nutritional deficiencies would undoubtedly have become widespread

## VII GENERAL CONCLUSIONS

It has been pointed out in the Introduction that one of the deepest impressions carried away by those who attended the meetings, at which the planning of relief measures was begun, in February 1945 was that, caused by the revalation that little or nothing of a precise character was then known about the proper treatment of those suffering from prolonged and grave starvation.

If this Report serves no other purpose than to establish what are the broad lines along which a similar crisis could be approached in the future, more particularly under European conditions, its publication will be justified.

From what is recorded in this Report there emerges a clear picture of a condition primarily due to a serious deficiency of energy (calories), inevitably involving lack of protein. Specific disorders of health attributable to lack of vitamins or mineral elements did not complicate the situation to any significant extent.

It is interesting and important that this was the case. It illustrates in a manner even more striking than did the experience recorded in other liberated territories, France, Belgium and the Southern Netherlands, that curtailment of food supplies enforces the consumption of the whole of cereal grains and as large a quantity of vegetable foods as can be acquired. Up to a point, this assures a measure of nutritional protection that reduces materially the danger that health will be harmed. It should be born in mind in this connection that the requirements of the body for certain of the vitamins are reduced as the energy intake becomes less.

The data of the intake of vitamins and mineral elements recorded in this Report should be of value in clarifying views on the minimal quantities that are compatible with the absence of signs of deficiency disorders.

The inadequacy of knowledge in early 1945 regarding the treatment of those in advanced stages of starvation led to certain assumptions being accepted. Some of these, which originally influenced strongly the approach to the problem, proved to be unfounded in the light of experience subsequently gained. As an illustration in point, the preparation of predigested foods may be given. It was the unanimous opinion of the experts consulted in February 1945 that the provision of such material, suitable either for oral or intravenous administration should be made. A great deal of high pressure work was involved as supplies had to be ready in the shortest possible time. The expense was very great but this was of no importance if the provision of such material would save thousands of lives that otherwise would be lost.

What subsequently happened proved beyond question that predigested foods of the type of protein hydrolysate are not essential for resuscitating patients in the last stages of exhaustion from starvation.

The observations on the digestive power of seriously starved persons are of considerable importance.

There is ample evidence in the investigations recorded here that the gastro-intestinal tract of such persons can digest foods such as separated milk and even a large quantity of fats (butter) with a facility that was not expected. Only in the very last stage of starvation, when the patient is almost moribund, was direct feeding of no value; indeed, experience in the Western Netherlands indicated that there is no available treatment that will resuscitate such cases.

Preconceived ideas that investigations would show that hunger oedema would

be explained on the simple biochemical and physical basis of lowered plasma protein and osmotic pressure, were rudely shattered There resulted on the other hand the universally expressed opinion that the oedema was due to a disordered function of the capillaries leading to undue permeability The individual factors involved in this disordered action were unfortunately not identified

Although it may appear at first sight, to be stressing the obvious, it is important to emphasise that what the starving person needs is food and plenty of it The experience in the Western Netherlands did not support the popular view that they need carefully nursing back to a condition in which they can take a full diet

It may be that when starvation is complicated by serious vitamin deficiencies, as often it was in the Far East, the condition is not as simply dealt with as was that characteristic of patients seen in the Western Netherlands Even when near the point of death the patients there could with rare exceptions swallow and digest relatively large quantities of simple food mixtures, based chiefly on the use of separated milk powder Their recovery was then so rapid, that within a day or two there was almost no limit to what they could eat and digest

The importance of putting a starving person as quickly as possible on a diet of high energy value and high protein content cannot be overemphasized The bearing of this important fact on the scale of food provision for relief of severe starvation may be of the utmost importance in the future

Valuable lessons were learned from the experience of the medical feeding teams, the personnel of which engaged their task in the early days of May 1945 with great enthusiasm but with very little idea what their difficulties would be The psychological condition of an underfed population constituted one of the greatest difficulties the teams encountered The peculiar psychological state of individuals suffering from severe and prolonged caloric shortage makes it necessary to pay the utmost attention to methods of approach imparting of information and understanding of mental states Apathy and irritability are the outstanding features in such a situation, which calls for special attention not only in regard to the relation between doctors and patients but to the difficulties of dealing with civilian authorities Good understanding will avoid delay of action and therefore be of life saving importance In any organisation for dealing with a similar emergency in the future attention should be given from the earliest day of planning to this important aspect of undernourishment and starvation

The organisation of the special medical feeding teams was shown to be somewhat inelastic when work in the field commenced The peculiar difficulties of the problems to be dealt with had not all been foreseen Care for out patients needed a different type of organisation from that needed for operating special hospital wards for starvation patients Communal feeding of the polyclinic groups called for another type of a unit

Another unexpected complication of the feeding of the liberated towns had not been anticipated Food stocks were exhausted when the Allied forces entered in the Western area For a few days before actual liberation came food in considerable quantities had been reaching the area by air and by road Notwithstanding every effort on the part of all concerned in food distribution, delays caused by sorting, stockpiling and accolating supplies resulted in large numbers of people going without any food at all for the best part of a week This was a period of acute danger for those who where already in a severe nutritional state at the time

of liberation. In future emergencies every possible measure should be taken to avoid such a delay.

In the past the world has too often accepted mass starvation as a natural calamity.

The experience of the Western Netherlands in 1945 came near to being one that would have gone down in history as a very terrible catastrophy. Had the German occupying Forces held out another two or three weeks against the Allied attack, nothing could have saved hundreds of thousands in the towns of the Western Netherlands from death from starvation. How many did in fact die will never be known, but it is probable that at least 10.000 lost their lives by starvation because the occupying power failed in its obligation to sustain civilian population that was under its authority.

The Editorial Committee wishes to record its considered opinion that there is no justification for the ruthless sacrifice of a civilian population in such circumstances and that the United Nations should devise a Convention of international scope of which the object would be to protect civilians subjected to an occupying power from suffering grave injury to health as a result of inadequate nourishment.

## VIII ACKNOWLEDGEMENTS


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J M Hagemeyer
R Lichtveld
H A Ruhe
J Kalhorn
Th Weggelaar
C Postma

Headnurses, administrators, inquiry officers social workers and drivers co operated in the teams with great devotion

Moreover a number of persons living in the towns where the teams operated, joined the organization and rendered assistance

Because it is impossible to mention the names of all those co operators we want to thank them all for their willing help and invaluable assistance

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The Oxford Survey Team wishes to make special mention of the pleasure it has had in cooperating with its colleagues in the Netherlands, and in particular of the generous welcome which it coming from the University of Oxford, received from the University of Leiden

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# IX SUPPLEMENT

## HEALTH CONDITIONS IN THE NETHERLANDS TWO YEARS FOLLOWING LIBERATION

by Dr C Banning

Chief Inspector of Public Health in the Netherlands

This brief review is limited to a consideration of the factors which are considered as indices of the public health i e availability of foodstuffs birth and death rates and population changes

In general the *nutritional status* of the population appears to be fair in 1947 The rations are not fully adequate and are certainly somewhat monotonous At the present time 1 June 1947 the average adult consumer receives rationed food equivalent to a caloric value of ± 1500 cal per day In addition to rationed foods potatoes pulse vegetables fruit and fish can be purchased without coupon The average quantity of the latter foodstuffs available per individual must be added to the quantities of rationed food to give the total foodintake Figures 57 and 58 show these allowances by weeks and by age and occupational group

In figures 59 60 and 61 weekly protein fat and carbohydrate intakes are shown By current nutritional standards these diets are not considered to be well balanced Pediatricians report that they are seeing an increasing number of infants suffering from scurvey (Barlow s disease) The factors causing this vitamin C deficiency are being investigated

After the experience of 1944 and 1945 no one would deny the deleterious influence

P ... *on increases* In ... average yearly ... In connection ... by years from 1935 to 1945 In this last ten year period an approximate 12 % increase in population was observed Since the year 1830 this had been an average of almost 1 % increase *per year* Line graph in fig 62 shows the average percentage increase by decade for the century 1830—1940

*Birth rates* remained at fairly constant level from 1935 through 1941 ranging from 19 8 to 20 8 per 1000 inhabitants Beginning in 1942 there was an irregular rise up to 1945 In the first full postwar year there occured a marked increase which reached 30 2 per 1000 inhabitants and from fig 64 the increase is shown to occur for the greater part in families with one more children

*Marriages* reached its lowest level in 1944 with some increase in 1945 it was followed by a sharp rise in 1946 reaching a level of 11 4 per 1000 inhabitants (see fig 65 )

The *general mortality* rates for the Netherlands in 1936—1946 are shown in fig 66 The four year period 1935—1939 was the most favourable in any period in the history of the Netherlands The range of 8 5—8 8 per 1000 inhabitants was very encouraging At the outbreak of the war there was noticeable rise in the

years 1940—1943 with a slight dip in 1942 In 1944 there was an abrupt rise reaching a peak of 14 2 in 1945 The pre war level was reached again in 1946 However a false impression may be obtained from this graph Many of the elderly and less robust persons who would normally be expected to die in 1946 and later, formed the group who suffered in the starvation period

Fig 67 gives a similar but clearer picture of mortality in three of the largest cities in the Western Netherlands Fig 68 shows the mortality among infants below one year per 1000 live births for the years 1936 up to 1946 In 1939 the rate was 33 6 deaths per 1000 live births the lowest on record in the Netherlands With the outbreak of war there was an immediate increase with a first peak in 1941 at which time the rate was 43 6 The years 1942 and 1943 show slight decrease in the infant mortality rate However the year 1944 shows a second rise to 46 0 Statistics for 1945 are not yet available because of disorganization of reporting services it is however expected that the peak will be considerably higher than in 1944 because conditions were much worse during the first five months of that year In 1946 the rate of infant death had again decreased to 38 8 per 1000 live births It will be of interest to report that the rate for the months of January 1946 was 69 1 as compared to 40 6 for January of 1947 So it is anticipated that there will be further improvement later in 1947 and perhaps the pre war level of 1939 may again be reached At that time the Netherlands was high in the list of countries with low rates of infant mortality

Since *tuberculosis* appears to be one of the best indicators of health status it is of interest to show the trend of both mortality and morbidity In chapter VIa of the main report the association of tuberculosis with nutrition has been mentioned From fig 69 it is seen that from the year 1939 when the death rate was at its lowest level of 4 1 per 10 000 inhabitants there was a gradual rise in rate until 1944 when it was 7,9 In 1945 reliable statistics were not available By 1946 the death rate had decreased to 4 7 reaching the 1937 level

The war influence is again shown in fig 70 In Amsterdam only the actual rate is known in 1945 and reached 10 8 per 10 000 inhabitants

The low tuberculosis mortality rate of 1946 does not necessarily reflect the morbidity from this disease in fact in reviewing the number of admissions to sanatoria during 1939 the admission with active tuberculosis was 4646 as compared with 6786 in 1946 with no less than 4000 on the waiting list It was generally agreed by the tuberculosis specialists that morbidity was nearly twice the pre war figure

FIG 57. Average caloric food intake per head day and age groups, including distributed food and average intake of non distributed nutrients (fish, pulse, vegetables, fruit, biscuit)

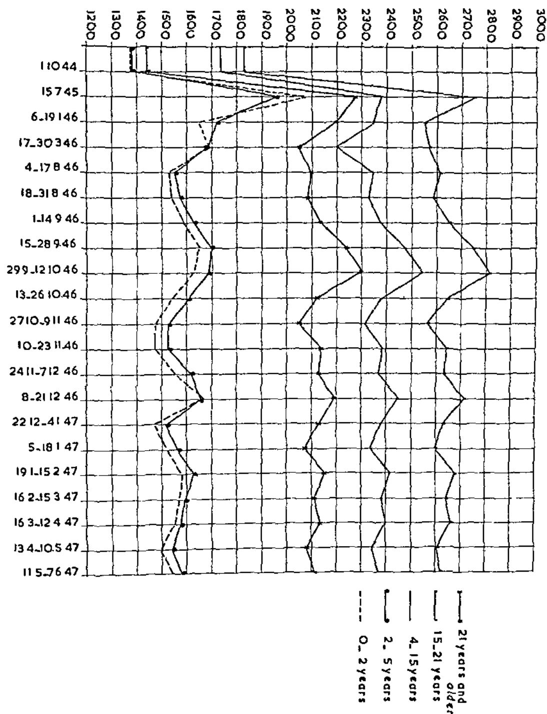


FIG. 58. Average caloric food intake per head and day in special groups including distributed food and average intake of non distributed nutrients

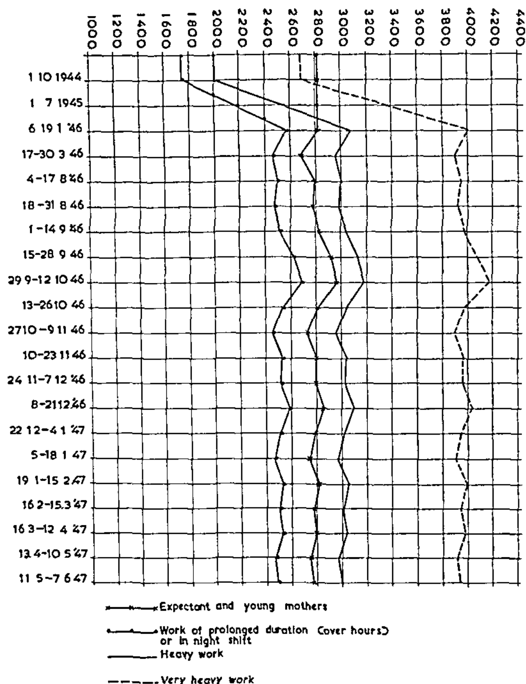


FIG 59 Protein intake in all categories of fig 57 and 58

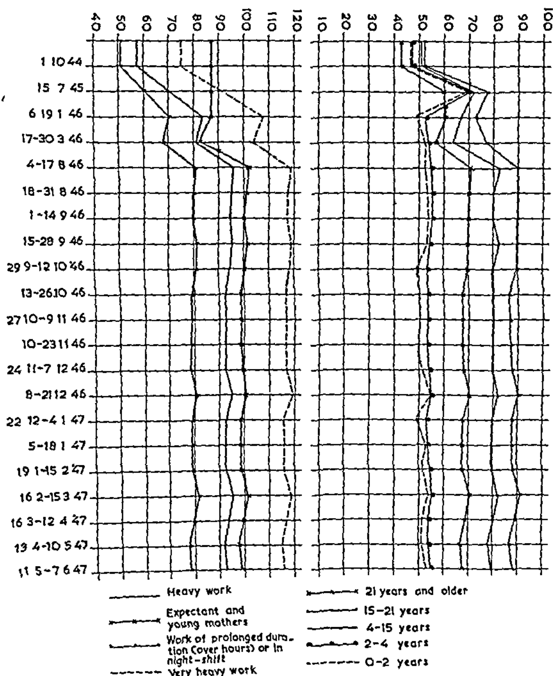


FIG 60 Fat intake in all categories of fig 57 and 58

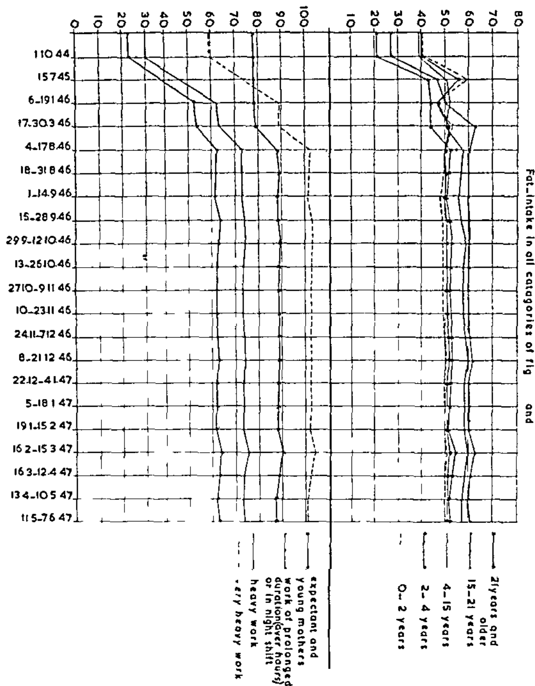


FIG 61 Carbohydratd intake in all categories of fig 57 and 58

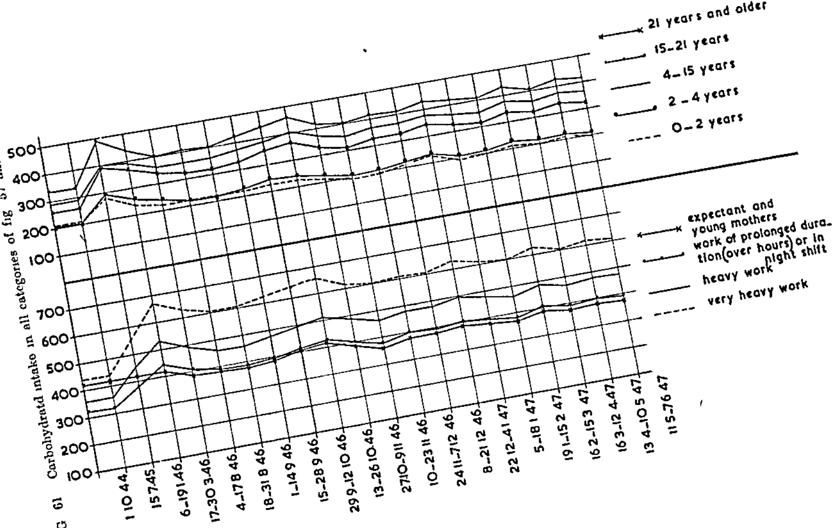
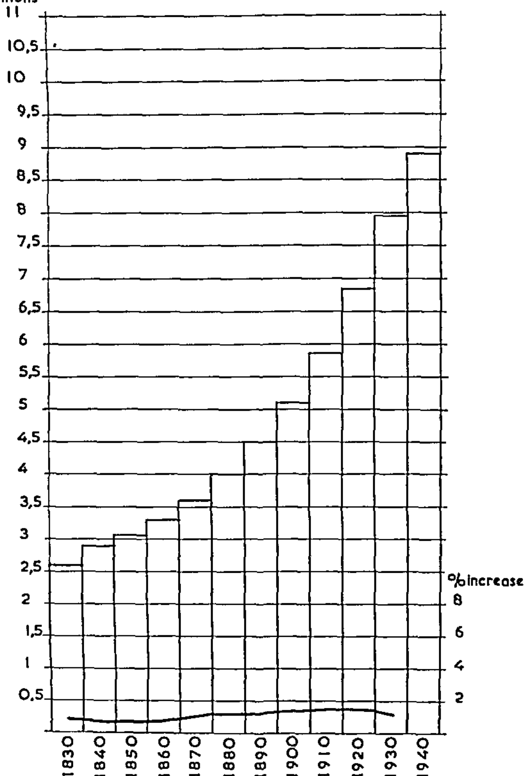


FIG 62 Absolute and procentual increase of population



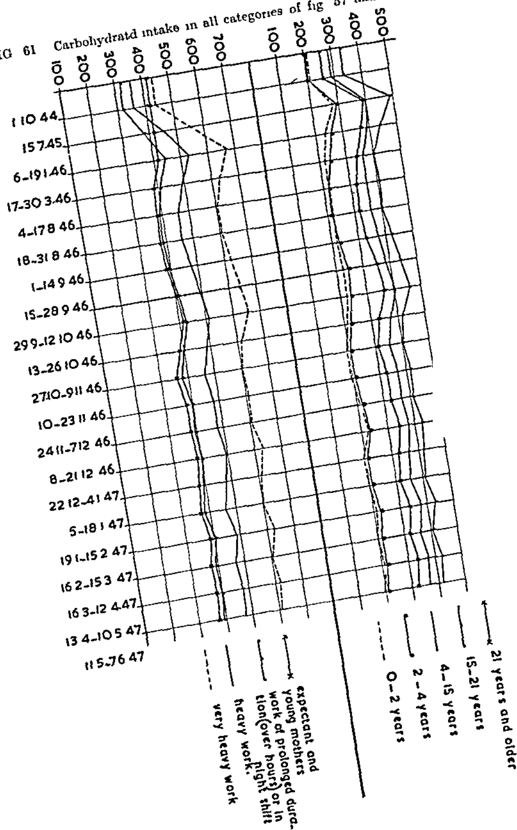



FIG 61 Carbohydrate intake in all categories of fig 57 and 58

FIG 62 Absolute and procentual increase of population

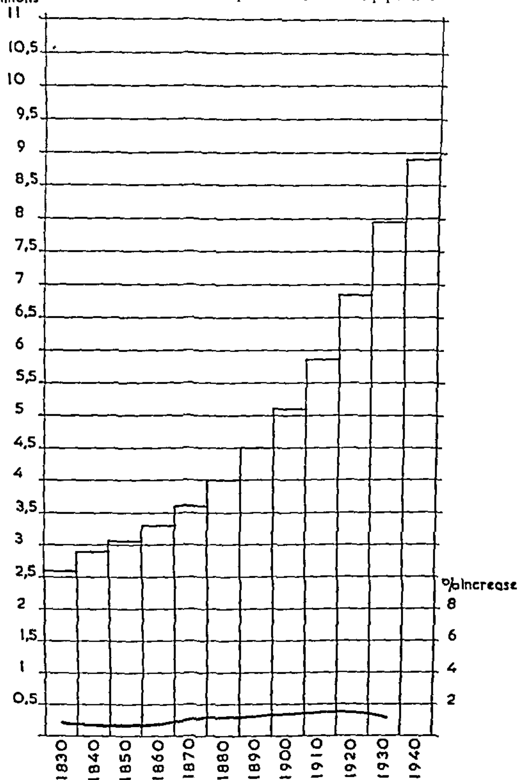


FIG 63 Average increase of population by decade

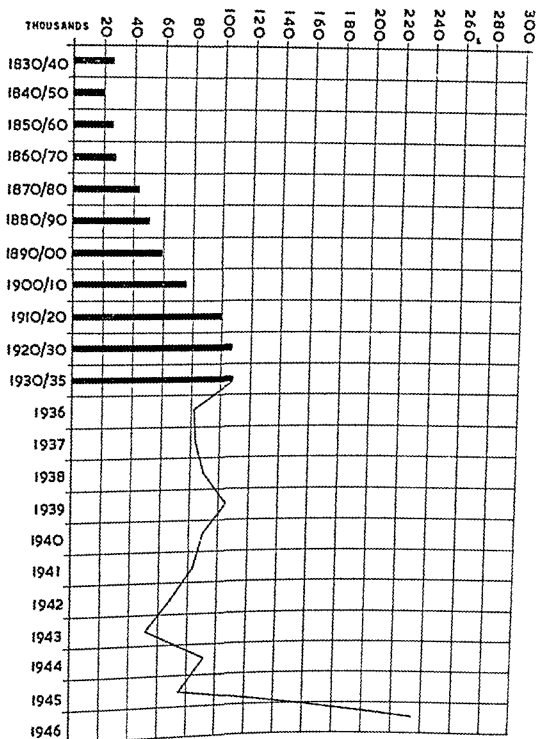


FIG. 64 Live births per 1000 inhabitants

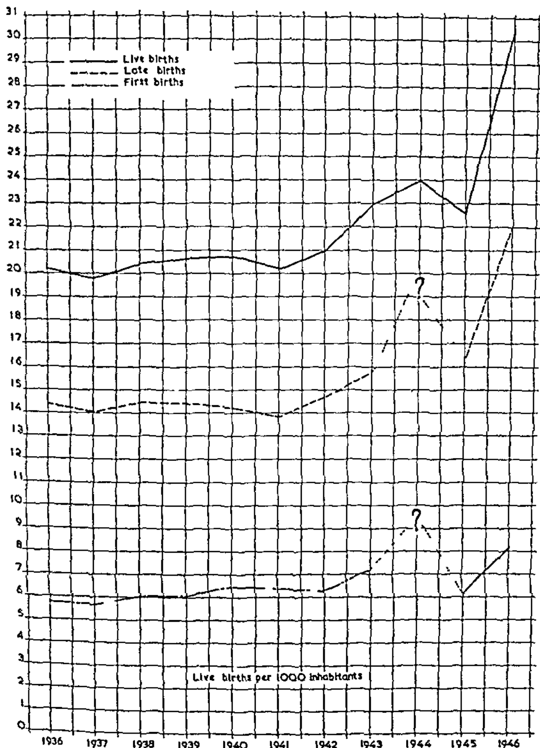
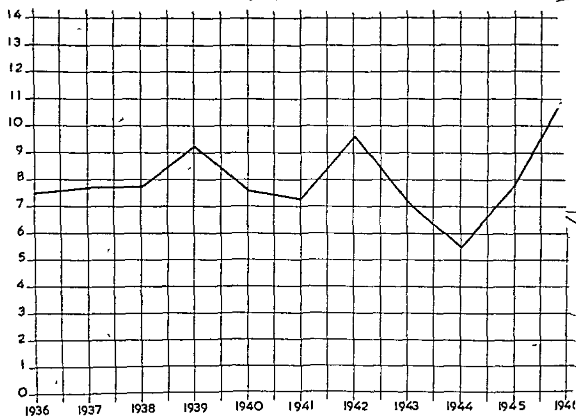


FIG. 65



Marriages per 1000 inhabitants
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945

FIG 69

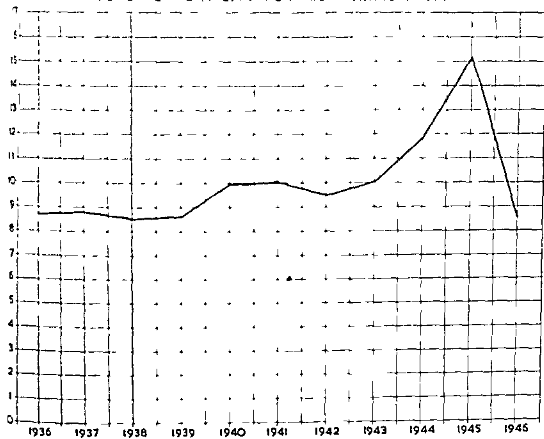
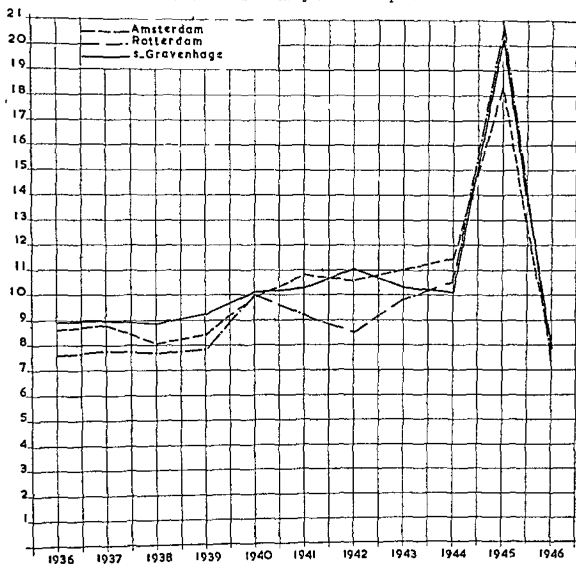
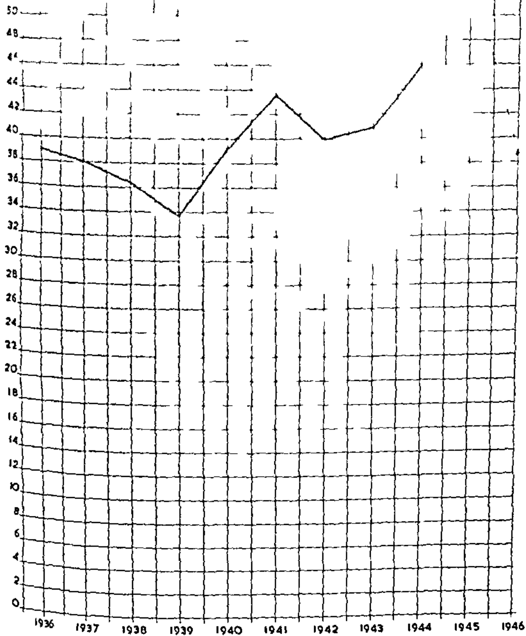

GENERAL MORTALITY PER 1000 INHABITANTS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946

FIG. 67 Total mortality in 3 municipalities




50
48
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946